Does Open Enrolment Increase Sorting?·

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Abstract

We investigate how the introduction of open enrolment legislation in British Columbia, Canada, affected the way that Kindergarten and Grade 4 students are sorted across schools and residential areas. We find weak evidence that open enrolment increased inter-school sorting on achievement, but little evidence that it increased sorting on ethnicity or home language. On the contrary, we find some evidence that it arrested the pre-policy trend toward increased ethnic segregation in schools and residential neighborhoods. We also find evidence that open enrolment shifted enrolment from lower-achieving schools to higher-achieving schools. This enrolment shift reduced ethnic segregation at higher-achieving schools, but had the opposite effect at lower-achieving schools.

JEL codes:
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1. INTRODUCTION

Public school open enrolment policies allow parents to enroll their child in a regular public school other than their local neighborhood school. In recent years, open enrolment policies have been implemented widely in the United States. As of 2005, for example, twenty-seven states had passed legislation mandating school districts to implement intra-district school choice, and twenty states had adopted legislation mandating that school districts participate in inter-district choice programs (ECS 2005). Open enrolment policies also have been implemented in a number of other jurisdictions (e.g., England in 1998 and British Columbia, Canada, in 2002).

Like other policies that expand the scope for school choice, open enrolment is intended both to serve the needs of diverse students and to improve the quality of education through increased competition between schools. However, as an unintended side effect, open enrolment may affect the way that students are sorted across schools if different groups of parents respond differently to new opportunities for school choice (Fiske and Ladd 2000). By weakening the link between residential location and school assignment, school choice policies also may affect residential choice decisions (Epple and Romano 2003), and therefore residential sorting. These unintended effects may have important consequences; for example, racial and ethnic segregation may impede the integration of immigrants (Cutler et al. 2008a), and sorting on achievement may deprive low-achieving students of exposure to high-achieving peers (e.g., Hoxby 2003).

Open enrolment policies may cause school and residential sorting to increase or decrease, depending on the extent to which different groups are constrained by pre-policy enrolment rules and their ability to respond to the relaxation of these constraints, and on the distribution of preferences across groups (Epple and Romano 2003). For example, open enrolment could disproportionately expand the school choice options of minorities and lower-income parents, and thereby reduce inter-school sorting by income and ethnicity, if higher income parents enjoy more choice options initially (either through greater scope for residential mobility or better access to private schools; Epple and Romano 2003). On the other hand, minority and less educated families may lack the information required to make informed school choice decisions or may have different preferences over school characteristics (Hastings et al. 2009), parents may prefer

schools with ethnically similar populations (Schneider and Buckley 2002; Hastings et al. 2009), and popular choice schools may be selective in their admissions (Epple and Romano 1998); all of these considerations could increase inter-school sorting under open enrolment. Furthermore, increased sorting along one dimension (e.g., income or ethnicity) may increase or decrease sorting along other dimensions (e.g., achievement) as a by-product.

Previous empirical evidence on the effect of open enrolment policies on sorting is scant. Several recent studies decompose measures of inter-school sorting in a cross-section of public schools into a component associated with residential choice and a component due to "post-residential" school choice (Burgess et al. 2007; Bifulco et al. 2009; Koedel et al. 2010). The results suggest that open enrolment policies may contribute modestly to school-level sorting along a variety of dimensions. However, limitations imposed by the data used in these studies require the authors to assume that residential choices and private school enrolment decisions are not affected by open enrolment policies, and that no students would attend non-neighborhood regular public schools in the absence of an official open enrolment policy. Their resulting estimates of the effects of open enrolment on school-level sorting will be biased in ways that depend on the characteristics and preferences of families for whom these assumptions are invalid. Moreover, they are unable to provide any evidence of the effects of open enrolment policies on residential sorting and private/public sector substitution.

We use rich administrative data on Kindergarten and Grade 4 students in British Columbia (B.C.), Canada, to investigate the effects of an intra- and inter-district public school open enrolment policy on inter-school and residential sorting by ethnicity, home language and academic achievement. These data have several key features that allow us to overcome the weaknesses of previous research and credibly identify the effects of interest. First, our data span the introduction of a province-wide open enrolment policy in 2002. We exploit this feature to identify the policy's effects via several differencing methods. We directly estimate the effect of open enrolment on residential sorting; the effect of open enrolment on inter-school sorting, allowing for the endogeneity of residential choice; and investigate heterogeneous effects across schools with different characteristics. Second, our data include all students enrolled in both the

public and private systems, allowing us to directly measure the effects of open enrolment on public/private sector substitution.

We begin by examining the effects of open enrolment on system-wide sorting by ethnicity, home language and academic achievement. We create annual measures of inter-school sorting between 1996 and 2006 within a region that comprises fourteen public school districts. We decompose these measures of system-wide sorting into components attributable to residential sorting and to three types of post-residential school choice decisions: private school enrolment, magnet school enrolment, and enrolment in non-guaranteed neighborhood schools. We then test for statistically significant breaks in these time series, and compare the timing of these breaks to the likely timing of responses to the introduction of open enrolment. We find weak evidence that open enrolment increased system-wide inter-school sorting on achievement. At the same time, we find that open enrolment arrested the pre-policy trend toward increased system-wide ethnic segregation in schools and residential neighborhoods. Although private school enrolment contributes substantially to post-residential sorting, we find no evidence that the magnitude of this effect is influenced by the introduction of open enrolment.

We then turn to analysis of school-level outcomes. While open enrolment policies officially provide access to *all* regular public schools, parents are most likely to consider schools that are relatively proximate to their homes. The increased scope for inter-school sorting under open enrolment therefore will vary with the geographic concentration of schools within a relatively small area. We exploit this variation in the intensity of treatment that arises through local variation in school choice opportunities to identify the effects of open enrolment on school-level ethnic composition and test scores. We also allow the effects of open enrolment to vary with school-average achievement to reflect the relative desirability of new opportunities to enroll in high- and low-achieving schools. We find that open enrolment shifted enrolment from lower-achieving schools to higher-achieving schools, and this enrolment shift served to integrate higher-achieving schools while increasing ethnic segregation in lower-achieving schools.

2. RELATED LITERATURE

As described above, several recent studies decompose measures of overall sorting in a cross-section of public schools into a component associated with residential choice and a component due to "post-residential" school choice. Using observed residential choice and data on applications for cross-boundary transfers, Koedel et al. (2010) find that post-residential school choice under San Diego's open enrolment program increases the exposure of whites to Asians but segregates whites from blacks and Hispanics, and segregate students by student achievement and parental education levels. However, these estimated effects are small. Applying a similar strategy to data on school attendance, Bifulco et al. (2009) find that post-residential school choice in Durham, North Carolina segregates students by socioeconomic status. Burgess et al. (2007) similarly show that open enrolment in English Local Education Authorities contributes to school-level segregation by ability, disadvantage and ethnicity.

While these studies suggest that open enrolment policies may contribute modestly to school-level sorting along a variety of dimensions, they do not account for several dimensions of choice that could influence sorting outcomes. Most importantly, school choice policies that weaken the link between residential location and school assignment may affect residential choice decisions (Epple and Romano 2003). Recent evidence suggests that the effects of inter-district enrolment policies on residential choice can be substantial (Brunner et al. 2010a). Second, if parents view private schools and cross-boundary public schools as substitutes, then studies that implicitly assign all students to their guaranteed public school in the absence of open enrolment do not account for public/private school substitution. Indirect evidence about this trade-off is provided by Urquiola (2005), who finds that greater opportunities for Tiebout choice associated with a larger number of school districts in a given area reduce private school enrolment.

Some insight into the possible effects of open enrolment policies on school-level sorting is provided by evidence of heterogeneity in school choice preferences across different groups. Hastings et al. (2009) find that high-income parents of high-achieving students place a higher weight on test scores than other parents when selecting schools under an intra-district choice policy in Charlotte, North Carolina; and parents from all racial groups prefer schools where their

own race is the clear majority. They conclude that public school choice policies may lead to greater educational stratification of schools serving high- and low-income families.

A growing number of studies explore the impact of other types of school choice programs on student sorting across schools. Recent studies include Epple and Romano (1998), Epple, Figlio and Romano (2004), Hsieh and Urquiola (2006), Epple and Romano (2008) and Brunner et al. (2010b) in the context of private school vouchers; and Saporito (2003), Bifulco and Ladd (2007), Weiher and Tedin (2002), and Hanushek, Kain, Rivkin and Branch (2007) in the context of charter or magnet school choice.

3. INSTITUTIONAL CONTEXT

3.1 School choice and funding policies

School choice opportunities in British Columbia are similar to those in many other jurisdictions. Within the public sector, students are guaranteed access to the public school whose catchment area they reside in, or they may choose a non-guaranteed neighborhood school or a public magnet program.[4] Prior to 2003, access to a non-guaranteed regular public school required the permission of both the guaranteed school Principal and the preferred school Principal. The provincial education authority (the Ministry of Education) instituted an official "open boundaries" policy in July 2002 that allows students to attend any public school in the province that has space and facilities available after students in the catchment area have enrolled. When public schools are over-subscribed, provincial legislation requires that school boards give priority to students within the district over out-of-district students; boards may elect to give priority to siblings of children who are already enrolled in the school, and must establish policies for allocating priority among students within a priority category. Transportation to choice schools is not provided.

[4] The most popular form of magnet program is French Immersion, which enrolls about 10 percent of Kindergarten students in the province (B.C. Ministry of Education 2011). Entry into French Immersion programs is restricted to students entering Kindergarten or Grade 1, and space in popular magnet programs is often allocated by lottery.

Provincial funding rules ensure that all public school districts have the same access to revenues. The 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.

Parents may also choose to enroll their children in "independent" schools that charge tuition (commonly referred to as private schools). Independent schools that conform to provincial curriculum standards and meet various provincial administrative requirements are entitled to provincial operating grants that range from 35 percent of the public school grant for independent schools with relatively high operating costs, to 50 percent of the public school grant for independent schools with relatively low operating costs (B.C. Ministry of Education 2005).

3.2 Assessment and information

A number of studies have demonstrated that the provision of information about school-level achievement may influence both school choice (Hastings et al. 2007; Hastings and Weinstein 2008; Friesen et al. 2011) and residential location decisions (Figlio and Lucas 2004; Fiva and Kirkebøen 2008). Like many jurisdictions, British Columbia publicly releases information about school-level achievement on standardized tests.[5] This information was first released in the 2000/2001 school year, when the Ministry of Education provided individual and 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). In October 2001, the results of the 1999/2000 and 2000/2001 exams were posted on the Ministry's website in (B.C. Ministry of Education 2001), and each subsequent set of results has been posted the following fall. Beginning in 2003, schools were required to share individual students' exam results with parents

[5] Since the 1999/2000 school year, all public and provincially-funded private schools have been required to administer standardized Foundation Skills Assessment (FSA) exams to students in Grades 4 and 7 in May of each year. Students are examined in Reading Comprehension, Writing, and Numeracy. The FSA exams 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.

before September 30 of each school year. An independent organization (the Fraser Institute) began issuing annual "report cards" on B.C.'s elementary schools in June 2003 (Cowley and Easton 2003). These reports include school scores constructed by the Fraser Institute from standardized exam results, and rankings based on these scores. From the outset, the Fraser Institute's school report cards have received widespread media coverage in the province's print, radio and television media.[6]

4. DATA

Our estimates are based on extracts from two administrative databases collected and maintained by the BC Ministry of Education. The first is an enrolment database that records the school at which each Kindergarten and Grade 4 student is enrolled on September 30 of each year. Our extract from this database spans the 1996/1997 through 2006/2007 school years. 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., 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. The second database provides students' Grade 4 FSA test participation and scores for the 1999/2000-2005/2006 school years. We merge students' FSA scores with the enrolment database via the unique student identifier provided in both files.

We augment this enrolment and test score data with information about the characteristics of the student's neighborhood. To do so, we match each student's postal code with a corresponding Census geographic area.[7] We then attach the following characteristics of that geographic area by year, based on the most recent Census of population: the percentage of the population that are

[6] A ProQuest search of Vancouver's two most widely-read daily newspapers (the Vancouver Sun and the Province) returned twelve articles (including editorial content) published about the Fraser Institute's first elementary school report cards in June, 2003.

[7] The link is based on Statistics Canada's Postal Code Characteristics File (PCCF) which identifies the enumeration area (prior to 2001) or dissemination area (2001 and later) that the postal code lies within. These are the lowest-level geographic areas for which public-use Census data are produced, and typically comprise several hundred households.

immigrants to Canada, whose home language is English, Chinese, or Punjabi, and who are Aboriginal; average family income; and the proportion of families who are low-income.

We identify students' guaranteed catchment school using a cross-walk file that links residential postal codes to school catchment area boundaries collected from districts in 2007. Unfortunately, detailed historical information about catchment area boundaries prior to 2007 was not available. In order to minimize measurement error associated with changes in catchment area boundaries between 1996 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. All such cases were assigned a missing value for their catchment area school in the relevant years. Details of this procedure are described in a data appendix.

We restrict our attention to students enrolled in Kindergarten or Grade 4 in a non-Francophone public or private school located within the geographic boundaries of the fourteen school districts in the Lower Mainland of B.C.,[8] attending a school that enrolls at least five students in the relevant grade, and has non-missing values for all relevant variables. Summary statistics follow.

4.1 Characteristics of the student population

The share of the student population falling into each of our ethnic and linguistic categories during our 10-year sample period is shown in the first column of Table 2. Non-Aboriginal English language students are the largest group, accounting for over 62% of students. Students who report speaking a Chinese language at home (including Mandarin and Cantonese, as well as "Chinese") form the largest non-English home language group (11.3%), followed by Punjabi-speaking students (6.6%). The "other" home language category includes a large number of different languages, which together account for 14% of the student population. Students who report Aboriginal identity make up 5.7% of students. The remaining columns of Table 2 show substantial variation across these groups in achievement and in the incidence of identified disabilities and giftedness. English- and Chinese-language students are above average in terms

[8] 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 Strait of Georgia to the west.

of measured achievement and gifted designations. Chinese-language students also have a below-average incidence of disabilities, and clearly excel in numeracy. Punjabi-language and Aboriginal students score well below the mean on standardized reading and numeracy tests, and are substantially less likely than other groups to be designated as gifted. Aboriginal students have very high disability rates.

Figure 1 plots the annual population shares for each group of Kindergarten students between 1996 and 2006. The share of non-Aboriginal English language students declined by 5 percentage points to just over 63% between 1996 and 2000, and remained relatively stable thereafter. The share of Chinese language students (measured on the left-hand scale) fell slightly over the period, and was eclipsed by the growth of Punjabi home language students, whose share grew from 5.6% to 9.3% of students. The share of the "other" home language category grew from 10.3% to 14.3% over the period. The share of students who reported Aboriginal identity declined steadily from 6.9% to 4.6%.

4.2 Patterns of school attendance

Figure 2 shows that the proportion of Kindergarten students enrolled in regular public schools, French Immersion programs and independent schools. During this period, the share of enrolment in regular public schools (including students attending their assigned neighborhood public school and those attending an alternative regular public school) declined by 7.8 percentage points to 75.9 percent (shown on the right-hand scale). This decline was offset by increases in enrolment in French Immersion programs and independent schools. The proportion of students enrolled in French Immersion nearly doubled over the sample period to 10.1 percent in 2006, (shown on the left-hand scale); the proportion of students attending independent schools increased by 3.6 percentage points to 14.1 percent.

4.2.1 Identifying the effect of open enrolment on system-wide trends

Identifying whether the introduction of open enrolment affected system-wide trends in school attendance or sorting is difficult for several reasons. First, because the policy affects all B.C. students, there is no control group of individuals (or schools) in B.C. that was not subject to the

policy change. Second, although open enrolment legislation took effect in July 2002, the effective implementation date of the policy could have been earlier or later. On the one hand, school administrators and parents may have anticipated the legislation and changed their behavior prior to July 2002. On the other hand, if parents were unable (or unwilling) to immediately alter their residential and school choice decisions in response to the policy change, the effective implementation date of the policy could have been substantially later than July 2002. These considerations make it impossible to determine the timing of any possible effect of open enrolment on system-wide sorting a priori.

Following Piehl et. al. (2003), we apply an unknown-breakpoint test from the time series literature to determine whether the introduction of open enrolment affected system-wide sorting; and if so, the timing of that effect. The test is based on Andrews (1993) and is easily implemented.[9] Note that if the open enrolment policy had an immediate effect, then the measured break year will be $t^* = 2001$, since the school year beginning in September 2002 is the first school year following the introduction of open enrolment legislation.

Figure 3 distinguishes between students enrolled in the public school sector who are attending their assigned neighborhood school and students who attend an "out-of-catchment" regular public school. These data may be subject to two sources of measurement error, both of which would bias the measured share of students in regular out-of-catchment schools upwards. First, errors in recorded postal codes will cause some students to be mistakenly assigned to a catchment area school and recorded as being out-of-catchment when they are not. Note that we have no reason to expect that this source of measurement error would vary over time. Second,

[9] Let Y_t denote an outcome of interest such as the proportion of students who attend a school other than their neighborhood school, and let $d_t^{t>t^*}$ be an indicator variable that takes value 1 if $t > t^*$ and 0 otherwise. Consider the simple intercept and trend model:

(1) $$Y_t = \alpha_{t^*} + \beta_{t^*} t + \gamma_{t^*} d_t^{t>t^*} + \delta_{t^*} d_t^{t>t^*} t + \varepsilon_t.$$

The coefficient γ_{t^*} measures a change in the intercept following a break year t^*, and δ_{t^*} measures a change in trend in the same year. We estimate (1) for each $t^* \in \{2000,2001,2002,2003\}$, and implement the usual Chow (Wald) test of the null hypothesis $H_0: \gamma_{t^*} = \delta_{t^*} = 0$ for each of these specifications. If the supremum of the Wald statistics exceeds an asymptotic critical value given by Andrews (1993), then there is a break in the level and trend of Y_t, and the value of t^* associated with the supremum of the Wald statistics is the year of the break.

our use of catchment area boundaries from 2007 will similarly cause errors in our assignment of students to catchment area schools if catchment area boundaries changed over time in ways that we were not able to account for. The difference between actual catchment boundaries and the 2007 boundary maps will be smaller in later years when actual catchment area boundaries conform more closely to the 2007 boundaries used to assign students to catchment areas. Any upward bias introduced by unobserved changes in catchment area boundaries will therefore decline over time, biasing any measured growth in out-of-catchment enrolment *downwards*.

With these caveats in mind, Figure 3 shows a clear break in the share of students who attend their catchment area school and the share who attend a regular out-of-catchment public school that coincides with the introduction of open enrolment in 2002. Indeed, the Andrews (1993) test for an unknown breakpoint described above indicates that there was a statistically significant break in both series between the 2001 and 2002 school years.[10] Between 2001 and 2006, the share of students attending an out-of-catchment regular public school increased by 5 percentage points to 22.6 percent.[11] Over the same period, the share of students attending their neighborhood catchment school declined by 8.7 percentage points, reflecting both the growth in out-of-catchment public school attendance and the continuous growth of enrolment in independent schools and French Immersion programs.

An increasing share of students in *all* of our ethnic and language groups chose to attend regular non-catchment public schools under open enrolment (Figure 4). The increase was greatest among Aboriginal students (9.2 percentage points between 2001 and 2006), followed by English-speaking students (5.1 percentage points), other home-language students (4.9 percentage points), Punjabi-speaking students (4.5 percentage points) and students speaking a Chinese home language (4.4 percentage points). Over the same period, private school enrolment saw little

[10] The supremum of Wald statistics for the public in-catchment series is 98.2 for $t^* = 2001$; the corresponding statistic for the public out-of-catchment series is 41.4 for $t^* = 2001$. In both cases, the 1% critical value is 9.21.

[11] 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 (Ozek 2009), and the 6.6% participation rate in San Diego's open enrolment program (Zau and Betts 2005).

growth for most groups (Figure 5; Punjabi-speaking students are the exception), while enrolment in French Immersion programs grew (Figure 6; again Punjabi-speaking students are the exception). As a consequence of these enrolment shifts, students from all language groups were between 8 and 11.5 percentage points less likely to attend their neighborhood public school than they were in 2001 (Figure 7).

5. SYSTEM-WIDE ANALYSIS

5.1 Methodology

5.1.1 Measuring and decomposing ethnic and linguistic segregation

We measure ethnic and linguistic segregation using an adaptation of the Duncan and Duncan (1955) dissimilarity index. Consider a student population composed of multiple ethnic/linguistic groups indexed by j, and let P_{jt} denote the proportion of the year t student population that belongs to group j. Students are said to be *evenly* distributed across schools if each school's ethnic/linguistic composition is the same as that of the population as a whole; that is, if the proportion of students in school s belonging to group j is exactly P_{jt} for each and every school s. The dissimilarity index measures the extent to which the distribution of group j across schools departs from evenness. Specifically, it measures the proportion of students in group j that would have to change schools to evenly distribute them across all schools.[12] The system-wide index of school dissimilarity for group j in year t is defined as:

$$D_{jt} = \frac{\sum_s |N_{sjt} - E_{sjt}|}{2P_{jt}(1-P_{jt})} \quad (2)$$

where N_{sjt} is the number of students in school s who belong to group j in year t, and E_{sjt} is the number of students in school s who would belong to group j under an even distribution, i.e., $E_{sjt} = P_{jt} N_{st}$ where N_{st} is total enrolment at school s in year t. The index takes values between zero and one, where zero indicates evenness, and one indicates maximum possible segregation.

[12] Allen and Vignoles (2007) argue that the dissimilarity index is preferable to alternate measures of segregation, such as the isolation index, for measuring school-level segregation. Whereas the dissimilarity index only reflects unevenness of the distribution of students across schools, the isolation index also reflects the overall size of the minority group. School choice decisions may affect unevenness but are unlikely to affect the minority share in the population.

The dissimilarity index for group *j* provides a measure of the segregation faced by that group, but does not provide an overall measure of segregation faced by all groups. The Sakoda (1981) generalized dissimilarity index provides such a measure. It measures the extent to which the distribution of *J* groups across schools departs from evenness. The system-wide generalized index of school dissimilarity in year *t* is defined as:

$$D_{Gt} = \frac{\sum_j \sum_s |N_{sjt} - E_{sjt}|}{2 \sum_j P_{jt}(1 - P_{jt})}. \tag{3}$$

The generalized dissimilarity index measures the proportion of all students that would have to change schools to achieve an even distribution of students across schools.

Carrington and Troske (1997) show that when groups or units (schools) are small, dissimilarity indices can depart substantially from zero even in the absence of systematic sorting. They consequently propose an adjustment to account for this possibility. We adopt their proposed adjustment here, because our data include both small schools and some small ethnic/linguistic groups. With this adjustment, the system-wide Carrington and Troske (1997) index of systematic dissimilarity for group *j* in year *t,* denoted $\widehat{D}_{jt}$, measures the difference between D_{jt} and its expected value when students are randomly distributed across schools.[13] Similarly, the system-wide index of systematic generalized dissimilarity in year *t,* $\widehat{D}_{Gt}$, measures the difference between D_{Gt} and its expected value when students are randomly distributed across schools.[14]

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[13] The index of systematic dissimilarity is defined as:

$$\widehat{D} = \begin{cases} \dfrac{D - D^*}{1 - D^*} & \text{if } D \geq D^* \\ \dfrac{D - D^*}{D^*} & \text{if } D \leq D^* \end{cases}$$

where $D \in \{D_{jt}, D_{Gt}\}$, $D^* = R^{-1} \sum_{r=1}^{R} D_r$, and $D_1, D_2, \ldots, D_R$ are R simulated values of the dissimilarity index under a random allocation of students to schools holding school size and group sizes constant. Note that $\widehat{D}$ takes values between -1 and 1. Negative values indicate that the distribution of students across schools is *more* even than would be expected under random allocation.

[14] The relevant baseline for these indices is a random distribution of students across schools, rather than an even distribution. That is, when $\widehat{D}_{jt} = 0$ the dissimilarity faced by group *j* is no greater than would be expected under a random allocation of students to schools. Similarly, $\widehat{D}_{jt} > 0$ measures the extent to which dissimilarity faced by group *j* exceeds the expected amount

These adjusted indices are also useful because they admit straightforward randomization tests of the null hypothesis that students are randomly distributed across schools.

Because most students attend their neighborhood (catchment area) public school, residential sorting is a key determinant of the degree of segregation that students face in schools. The actual degree of segregation that students face in schools, however, depends not only on residential sorting, but also on parents' post-residential school choice decisions. A convenient property of the system-wide indices of dissimilarity allows us to decompose them into components attributable to residential sorting, and components attributable to post-residential school choice decisions.

Our decomposition is based on the difference between actual system-wide dissimilarity, and hypothetical measures of system-wide dissimilarity under three counterfactuals. Let D_t denote one of the indices of system-wide dissimilarity defined above. The first counterfactual index of dissimilarity, D_t^1, is the value of D_t that we would observe if all students attended their catchment area school. This provides a direct measure of residential segregation, since it measures the extent to which the residential distribution of groups across catchment areas departs from an even (or random) distribution.

Given residential location, there are three avenues for parents' post-residential school choice decisions to contribute to system-wide dissimilarity: parents may choose to enroll their child in a public school other than their catchment area school; they may choose to enroll their child in a French Immersion magnet program school; or they may choose to enroll their child in a private school. To measure the contribution of these post-residential school choice decisions on system-wide dissimilarity, we compute two additional counterfactual indices: D_t^2 is the value D_t that we would observe under the counterfactual that all students attend their catchment area school *except those who attend a non-catchment area public school*; and D_t^3 is the value D_t that we would observe under the counterfactual that all students attend their catchment area school except those who attend a non-catchment area public school *and those who attend a French*

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under a random allocation, expressed as a fraction of the maximum amount of such excess dissimilarity that could occur; and $\widehat{D}_{jt} = 1$ is analogous to complete unevenness.

immersion magnet school. Because the dissimilarity indices is are linear in N_{sjt}, we have the following order-invariant decomposition of D_t:[15]

(4) $$D_t = D_t^1 + (D_t^2 - D_t^1) + (D_t^3 - D_t^2) + (D_t - D_t^3)$$

where D_t^1 is the component of system-wide dissimilarity attributable to residential sorting, $D_t^2 - D_t^1$ is the component due to enrolment in non-catchment area public schools, $D_t^3 - D_t^2$ is the component due to enrolment in French immersion magnet program schools, and $D_t - D_t^3$ is the component due to enrolment in private schools.

5.1.2 Measuring and decomposing sorting by achievement

To measure system-wide sorting on academic achievement, we decompose the observed variation in students' standardized test scores into the usual measures of within-school and between-school variation. Let T_{ist} denote the test score of student *i* when enrolled in school *s* in year *t*. We have the following decomposition of the total variance of students' test scores in year *t*:

(5) $$\frac{1}{N_t - 1}\sum_i (T_{ist} - \bar{T}_t)^2 = \frac{S_t}{N_t - 1}\left[\frac{1}{S_t}\sum_s (N_{st} - 1)V_{st}\right] + \frac{S_t - 1}{N_t - 1}\left[\frac{1}{S_t - 1}\sum_s N_{st}(\bar{T}_{st} - \bar{T}_t)^2\right]$$

where N_t is the number of students in year *t*, S_t is the number of schools, $\bar{T}_t$ is the overall mean of test scores, $\bar{T}_{st}$ is the average test score at school *s*, and $V_{st} \equiv (N_{st} - 1)^{-1}\sum_{i \in s}(T_{ist} - \bar{T}_{st})^2$ is the within-school variance of test scores at school *s* in year *t.* The first term on the right-hand of (5) is an enrolment-weighted average of within-school variation in test scores (the "within" component), and the second term is the enrolment-weighted variance of school-average test scores (the "between" component).

5.2 Results

5.2.1 System-wide sorting by language and ethnicity

The first column of Table 3 presents values of the system-wide adjusted generalized dissimilarity index for each year. Overall inter-school segregation in Kindergarten is moderately high and increased somewhat from .415 in 1996 to .471 in 2006. Values for Grade 4 are similar, though

[15] That is, the decomposition is invariant to the ordering of the counterfactuals, because D_t is linear in N_{sjt}.

the increase in dissimilarity over this period was more modest. According to Massey and Denton (1993), values of unadjusted dissimilarity between .3 and .6 are considered moderate; our estimates are at the upper end of this range.[16] The Andrews (1993) test described in section 4.2.1 identifies a statistically significant break in the adjusted generalized dissimilarity index for Kindergarten students between the 2000/2001 and 2001/2002 school years, but no statistically significant break for Grade 4.[17] Inspecting the data, however, it seems clear that there was no increase in segregation faced by Kindergarten students upon the introduction of open enrolment in 2002. Instead, it appears that the trend towards increased dissimilarity between 1996 and 2001 ended at the time that open enrolment was introduced; the adjusted similarity index was effectively constant thereafter.

The remaining columns decompose the overall level of dissimilarity into components due to residential sorting and post-residential school choice. About 87 percent of total inter-school segregation among Kindergarten students, and 89 percent among Grade 4 students is due to residential segregation. We find a significant break in the series measuring the contribution of residential choice to overall dissimilarity between 2000 and 2001.[18] As illustrated in Figure 8, there is some evidence that residential sorting by ethnicity and home language decreased (or at least, the rate of increase declined substantially) following the introduction of open enrolment. It is possible that expanded school choice options reduced parents' incentives to condition their residential location decisions on the ethnic composition of neighborhoods.

The remaining 11% to 13% of overall inter-school dissimilarity is accounted for by parents' post-residential school choice decisions. The total contribution of post-residential school choice to overall segregation in Kindergarten increased steadily between 1996 and 2006, from 0.045 to 0.065 (see Figure 8). However, we find no evidence of a statistically significant break in this series or any of its sub-components between 2000 and 2003; the rate of growth in the post-

[16] Estimates of the unadjusted dissimilarity indices are available on request. For Kindergarten students in our data, values of the unadjusted generalized dissimilarity index range between 0.522 in 1996 and 0.542 in 2006. For Grade 4 students, they range between 0.537 in 1996 and 0.575 in 2006.

[17] For the Kindergarten series, the maximal value of the Wald statistics is 48.0 for $t^* = 2000$; the 1 percent critical value is 9.21. For Grade 4, the maximal value is 2.65 in the same year.

[18] The maximal Wald statistic is 30.6 for $t^* = 2000$; the 1% critical value is 9.21.

residential component was more or less constant between 1996 and 2006. Hence we find no evidence that the introduction of open enrolment increased the overall degree of inter-school sorting beyond the level that would have existed absent the policy change.

It is worth noting that all school choice outlets contribute positively to the degree of segregation faced by students. Applying the randomization test proposed by Carrington and Troske (1993), we easily reject that the components of overall dissimilarity due to out-of-catchment enrolment and private school enrolment are zero in each year; for most years, the same is true of French Immersion enrolment. Interestingly, private school choice contributes more to post-residential sorting than out-of-catchment and magnet enrolment combined. This finding is consistent with previous evidence that private school vouchers may contribute substantially to school-level sorting.[19] The absence of any statistically significant break in this series between 2000 and 2003 suggests that the extent to which universal vouchers contribute to school-level sorting is not sensitive to the form of public school enrolment policies.

Tables 4 through 7 provide analogous decompositions of the adjusted dissimilarity index for English, Chinese and Punjabi home language students and Aboriginal students. The dissimilarity index values for English home language students are very similar to those for the generalized dissimilarity index, reflecting this group's majority status. Again, residential sorting is the primary driver of school-level sorting, and private school choices contribute more to sorting than the other forms of choice combined. As with generalized dissimilarity, we find a statistically significant break in the total school-level segregation faced by English language Kindergarten students between 2000 and 2001:[20] segregation increased in each year between 1996 and 2001, but was effectively constant at the 2001 level following the introduction of open enrolment. We

[19] Hsieh and Urquiola (2006) show that sorting across public and private schools in Chile increased following the introduction of universal vouchers. Brunner et al. (2010b) find that white households are more likely to support universal private school vouchers when their children attend schools with larger concentrations of nonwhite schoolchildren, but nonwhite households are not. This pattern of responses will increase sorting if white households also opt into schools with higher concentrations of nonwhite students at a lower rate than do nonwhite households, as several studies have shown to be the case (e.g. Bifulco and Ladd, 2007; Weiher and Tedin, 2002; Hanushek et al., 2007).

[20] The maximal Wald statistic is 30.7 for $t^* = 2000$; the 1% critical value is 9.21.

find a similar structural break in the component due to residential sorting between 2001 and 2002:[21] segregation due to residential sorting increased substantially between 1996 and 2001, but was effectively constant thereafter. As with overall segregation, the introduction of open enrolment appears to have stopped the pre-policy trend toward increasing segregation faced by English language Kindergarten students, and may have reduced parents' incentives to sort residentially on ethnicity and language.

Aboriginal students face the lowest dissimilarity of all our language/ethnicity groups, both because of low levels of residential dissimilarity and relatively low levels of post-residential sorting. Chinese and especially Punjabi home language students are substantially more segregated than the other groups, but this dissimilarity is driven almost entirely by residential sorting.[22] Post-residential school choice plays a relatively small role in school-level sorting of these groups, accounting for only 5-9% and 4-11%, respectively, of the total dissimilarity these groups face in Kindergarten. In most cases, the contribution of post-residential sorting was statistically insignificant. We find statistically significant breaks in the contribution of residential sorting to overall dissimilarity faced by Chinese and Punjabi Kindergarten students between 2000 and 2001.[23] Once again, the introduction of open enrolment appears to have slowed the pre-policy trend toward increasing segregation in schools, and to have reduced parents' tendency to sort residentially.

5.2.2 System-wide sorting by achievement

Table 8 decomposes the variance of Grade 4 reading and numeracy tests scores according to equation (5). To facilitate interpretation, we have normalized the variance of both test scores to one in each year (before applying our sample restrictions). The vast majority of variation in test scores is within schools: about 86 percent in the case of reading, and 83 percent for numeracy during our sample period. However, the between-school component of variation has increased

[21] The maximal Wald statistic is 14.1for $t^* = 2001$; the 1% critical value is 9.21.
[22] These values are similar to those obtained for the U.S. by Cutler et al. (2008), where the mean residential dissimilarity index in 2000 was .56 for Chinese immigrants and .59 for immigrants from India.
[23] For Chinese students, the maximal Wald statistic is 34.4 for $t^* = 2000$ and for Punjabi students the maximal Wald is 9.1 in the same year. The 1% critical value is 9.21, and the 5% critical value is 5.99.

steadily between the introduction of testing in 1999 and 2006: from 12.2 percent to 15.4 percent in the case of reading, and from 15.9 percent to 21.5 percent in the case of numeracy. There is no evidence of a break in the numeracy series that might be attributable to open enrolment. However, there is weak evidence of a break in the reading series between the 2002 and 2003 school years.[24] The magnitude of the increase in between-school variation in Grade 4 reading scores attributable to open enrolment is about 2.3 percentage points.[25] It is credible that open enrolment's effect on sorting by Grade 4 achievement would lag its effect on Kindergarten-level outcomes by one or more years, since most parents make choices about schools and residential location prior to Grade 4.

6. SCHOOL-LEVEL ANALYSIS

6.1 Methodology

6.1.1 Regression framework

As described earlier, it is reasonable to think that the *intensity* of the effect of the policy change varied across schools according to the number of local alternatives; i.e., the degree of competition that the school faced from nearby public and private schools.[26] We exploit variation in the degree of local competition faced by schools to identify the effect of open enrolment on school-level outcomes. We also allow the effects of open enrolment to vary with pre-policy school mean achievement to reflect the relative desirability of new opportunities to enroll in high and low-achieving schools.

[24] The maximal Wald statistic for the within-school component is 9.62 for $t^* = 2002$ and for the between-school component the maximal Wald is 10.4 in the same year. In both cases, the 5% critical value is 9.67, and the 10% critical value is 8.06.

[25] Between 1999 and 2002, between-school variation in Reading scores averaged 13.1 percent of total variation, versus an average of 15.4 percent for the 2003-2006 period.

[26] Previous research demonstrates that the physical distance between students' homes and alternative schooling options is a key determinant of the decision to opt out of a guaranteed school under intra-district school choice programs (e.g. Cullen et al. 2005; Hastings and Weinstein 2008; Ozek 2009). Burgess et al. (2007) find that post-residential sorting is greater under intra-district open enrolment in areas when students have access to a larger number of schools within a 10-minute driving radius.

We consider the effect of open enrolment on several outcomes: school-level indices of dissimilarity, school enrolment levels, school-average test scores, and the within-school variance of test scores. In each case, for a given school-level outcome Y_{st}, we base our inferences on a regression specification of the form:

$$(6) \qquad Y_{st} = X_{st}'\beta_X + C_{st}'\beta_C + d_t C_{st}'\delta_C + T_{st-1}\beta_T + d_t T_{st-1}\delta_T + I_{st}'\beta_I + \tau_t + \mu_s + \varepsilon_{st}$$

where X_{st} is a vector of observable characteristics of school s in year t, C_{st} is a vector of measures of the degree of local competition faced by school s in year t, d_t is an indicator for whether the open enrolment policy is in effect, T_{st-1} is the one-year lag of school-average test scores, I_{st} is a vector of measures of the information available to parents about school-level achievement, τ_t and μ_s are year and school effects, respectively, $\beta_X, \beta_C, \beta_T, \beta_I, \delta_C$, and δ_T are parameters to be estimated, and ε_{st} is stochastic error. In some specifications we treat μ_s as a fixed school effect, in which case identification is based on within-school variation only. In other specifications, we treat μ_s as a random effect (i.e., we cluster standard errors at the school level) and include district-level fixed effects instead. In this case, identification is based on both within-school and between-school variation within school districts.

The effects of primary interest are δ_C, and δ_T. The coefficient δ_C measures how the relationship between Y_{st} and the degree of local competition faced by the school changed after the introduction of open enrolment. Similarly, δ_T measures how the relationship between Y_{st} and lagged school-average test scores changed after the introduction of open enrolment. In both cases, there is no reason to expect these relationships to change during the sample period except as a consequence of the change in parents' school choice opportunities due to the introduction of open enrolment.

Our school-level indices of dissimilarity are adapted from Sakoda (1981). Our school-level index for group j measures the extent to which the proportion of students in school s belonging to that group departs from the population proportion of group j. Specifically, it measures the number of students that would have to move into or out of the school to equate the school-level

proportion of group *j* and the population proportion, relative to the number that would need to move under maximal possible segregation:

$$D_{sjt} = \frac{|N_{sjt} - E_{sjt}|}{DMAX_{sjt}} \quad (7)$$

where $DMAX_{sjt}$ is the number of students from group *j* who would have to move into or out of school *s* to achieve evenness under maximal possible segregation.[27] This index is bounded from below by zero (when the school proportion of group *j* students equals the population proportion) and from above by one (when the school proportion of group *j* students differs maximally from the population proportion). The school-level index of generalized dissimilarity is defined similarly:

$$D_{Gst} = \frac{\sum_j |N_{sjt} - E_{sjt}|}{\sum_j |DMAX_{sjt}|}. \quad (8)$$

6.1.2 Competition measures

We construct separate measures of public and private school competition as follows. First, we calculate the great circle distance (in km) between each student's residence and the school that he/she attends.[28] We use these distances to construct a circle centered on each school's postal code and with radius equal to the 75th percentile of the in-sample travel distance to that school.[29] We call this the school's travel circle, and denote it Θ_s. We define each student *i*'s local choice set as the set of all schools whose travel circle includes the student's residence, denoted $\Omega_{it} = \{s: i \in \Theta_s, t\}$. Then we count the number of public and private schools in each student's local choice set, denoted c_{it}^{pub} and c_{it}^{priv}, respectively. Finally, for each school *s,* we average the values of c_{it}^{pub} and c_{it}^{priv} over all students that reside within the school's travel circle, Θ_s. This

[27] $DMAX_{sjt}$ depends on school size, the size of group *j*, and whether group *j* is over- or under-represented in the school:

$$DMAX_{sjt} = \begin{cases} min(N_{st}, N_{jt}) - E_{sjt} & \text{if } N_{sjt} > E_{sjt} \\ max\left(0, \left(N_{st} + N_{jt} - N_t\right)\right) - E_{sjt} & \text{if } N_{sjt} < E_{sjt} \end{cases}$$

[28] Distance is based on the latitude and longitude of the student's residential postal code and the school's postal code.

[29] Travel distances may vary in response to open enrolment as school choice decisions change. We therefore fix the diameter of our travel circles using observed school choice decisions in the year preceding the introduction of open enrolment (2001).

defines measures of the amount of competition that school *s* faces in year *t* from public and private schools that are "near" the residence of each student that lives "near" school *s* in year *t*:

(9) $$C_{st}^{pub} = \frac{1}{\#\{i \in \Theta_s, t\}} \sum_{i \in \Theta_s, t} c_{it}^{pub}$$

(10) $$C_{st}^{priv} = \frac{1}{\#\{i \in \Theta_s, t\}} \sum_{i \in \Theta_s, t} c_{it}^{priv}$$

For a given school *s*, the school competition measures , C_{st}^{pub} and C_{st}^{priv}, vary over time as schools open and close nearby, and as the spatial distribution of students within the school's travel circle varies. Since travel circles are generally small (the mean public school travel circle radius in our data is about 1.6km), the latter source of intertemporal variation in the competition measures is arguably random.[30]

6.1.3 Information measures

Previous research demonstrates that publicly released information about school-level achievement affected students' probability of separating from their school during our sample period, and this effect varied across groups defined by neighborhood income and home language (Friesen et al. 2011). Moreover, the character of information available to parents about school-level achievement changed several times during our sample period. See Table 1 for a summary of these changes and their timing. To avoid confounding the differential effect of open enrolment on high- and low-achieving schools with any effect that changes in the character of information about school-level achievement may have had on parents' school choice decisions (and hence school outcomes), we include controls for publicly-available information about school level achievement, I_{st}, in our regression specification (6).

In principle, the effect of public information about school-level achievement on school outcomes depends on the pattern of school separations and accessions, which in turn depends on the information that parents receive about *all* schools in their local choice set. Thus we define I_{st} to

[30] B.C.'s open enrolment policy gives priority to within-district over cross-district transfers. 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%, indicating that priority rules did not always create a binding constraint on inter-district transfers. For this reason, we count schools within the specified travel distance from the student's home even if they lie within a neighboring district. We will investigate the sensitivity of our results to a definition of choice sets that excludes schools from neighboring districts in future work.

measure the information that parents have in year *t* about the academic performance of school *s* relative to local alternatives. We construct I_{st} in a manner analogous to our competition measures. For each student *i* in each year *t*, we rank all schools in the local choice set Ω_{it} on the basis of publicly-available information about school-average achievement on standardized tests. Because the number of schools in each student's local choice set varies, we normalize these rankings to lie between zero and one for each student, where one denotes the highest-achieving school in Ω_{it} and zero indicates the lowest-achieving school in Ω_{it}. Denote the normalized ranking of school *s* relative to alternatives in Ω_{it} by $r_{s|\Omega_{it}}$. Our information measure for school *s* in year *t*, I_{st} , is the average value of $r_{s|\Omega_{it}}$ over all students who reside in the school's travel circle in year *t*. Further details are provided in a data appendix.

The timing of public releases of information about school-average achievement allows us to identify the effect of *information* about school-average achievement separately from the effect of school-average achievement *per se* on school-level outcomes. In particular, the information about school-average achievement that was available to influence parents' decisions with respect to enrolment in year *t* was based on student performance on standardized tests in year *t*-2; see Table 1. In contrast, our controls for school-average achievement, T_{st-1}, are based on student performance on standardized tests in year *t*-1. Finally, because the character of information contained in public releases changed several times during our sample period, we allow our information measure I_{st} to take a different coefficient in each year (i.e., information about performance on the year *t*-2 test enters interacted with an indicator for the year it the information could first affect school outcomes, *t*).[31]

6.1.4 Additional Controls

Additional control variables in our regressions, X_{st}, are based on Census neighborhood characteristics. See Section 5 and the Data Appendix for additional details.

[31] If parents use Baysian updating to revise their evaluations of school quality, information released in year *t-1* will continue to influence school choice decisions beyond year *t*, but with a smaller weight. Friesen et al. (2011) find that the information released in B.C. during this period has very little effect beyond the year in which it was released.

6.2 Results

Table 9 presents regression estimates where the outcome variable is the school-level index of generalized dissimilarity (eq. (9)). The first panel corresponds to Kindergarten and the second panel to Grade 4. The first and second columns of each panel report specifications without fixed school effects, and the third and fourth columns add fixed school effects. The specifications reported in the second and fourth columns control for the information about school-average achievement that was available on year *t*. All specifications include a set of census neighborhood characteristics as additional controls, and observations are weighted by school enrolment in 2001. To ensure a relatively homogeneous sample of schools, these regressions are estimated on the population of regular (non-French Immersion) public schools.

The specifications without fixed school effects show that, before open enrolment, schools that faced more competition from other public schools were less segregated than schools that faced less competition. Open enrolment had no impact on this relationship. We also see that before open enrolment, higher-achieving schools were more segregated than lower-achieving schools. We see a strong reversal of this tendency under after the introduction of open enrolment. This is evidence that school choice decisions under open enrolment reduced ethnic segregation in higher-achieving schools.

The specifications with fixed school effects identify the effects of open enrolment from within-school *changes* in the number of competing schools and school-average achievement. The results show no relationship between changes in the number of public or private schools that a school competes with and school-specific dissimilarity at the Kindergarten level, either before or after the introduction of open enrolment. The results for Grade 4 are similar during the period before open enrolment. However, under open enrolment, an increase (decrease) in the number of nearby public schools increased (decreased) the level of ethnic segregation in that school. This result suggests that, when the number of school choice options increases within an open enrolment system, parents' choices increase school-level sorting according to ethnic and linguistic characteristics more than when school catchment boundaries are less porous. However the effect size is very small. Like the specification without fixed school effects, we again see strong evidence that segregation declined in higher-achieving schools under open enrolment.

The results for dissimilarity indexes for each of the ethnic/linguistic subgroups are available on request. The results are in general similar to those for the generalized dissimilarity index, although somewhat less precisely estimated. The main exception is Chinese-language students, for whom choice made under open enrolment *increased* the dissimilarity index for Chinese students in high achieving schools relative to low achieving schools in Grade 4.

The changing patterns of dissimilarity across low- and high-achieving schools suggests a differential pattern of sorting across schools at different points in the school achievement distribution, whether by intention or as an unintended by-product of school choice decisions that are motivated by other factors such as income or ethnicity. To further investigate the effects of open enrolment on parents' decisions to enroll their child in high- vs. low-achieving schools, we next investigate the policy's effect on school enrolment levels. The regression estimates are presented in Table 10. Before open enrolment, higher-achieving schools had lower Kindergarten enrolments than lower-achieving schools on average. After open enrolment, higher-achieving schools gained enrolment at the Kindergarten level relative to lower-achieving schools. This is true in all reported specifications, and provides strong evidence of a shift in parents' school choices toward schools with higher average test scores after the introduction of open enrolment. Taken together, the estimates in Tables 9 and 10 imply that open enrolment increased enrolment growth in higher-achieving schools, and this enrolment shift was integrative with respect to ethnicity and home language.

In Tables 11 and 12, we investigate the effect of open enrolment on sorting by academic achievement. The outcome variable in Table 11 is school-average test scores. All reported specifications indicate that under open enrolment, average test scores increased at schools that faced more competition from other public schools relative to those that faced less competition. This is evidence that the competitive pressure brought to bear by open enrolment improved academic outcomes. From the estimated coefficients on lagged test scores, we see evidence that school-average test scores were highly persistent prior to open enrolment. In the case of numeracy scores, we see some evidence that this persistence increased under open enrolment: the column 4 estimates imply that schools whose year *t*-1 test scores were above average (relative to

the schools' own average performance over this period) also tended to have above-average scores in year *t*. This is evidence of school-specific trends in average achievement, leading to increased dispersion in the between-school variance of school-average test scores. This complements our previous evidence that open enrolment increased system-wide sorting on academic achievement.

In Table 12, the outcome variable is the within-school variance of test scores. We see no evidence that open enrolment had any effect on the within-school variance of test scores via competitive effects. Prior to open enrolment, higher-achieving schools also tended to have a more heterogeneous student body (with regard to test scores). However, we see evidence that of a reversal in this relationship under open enrolment, particularly with regard to reading test scores. That is, under open enrolment, higher-achieving schools had a less dispersed distribution of test scores than lower-achieving schools. This suggests that under open enrolment, it was generally higher-achieving students who sorted into higher-achieving schools. In contrast, the test score distribution became more dispersed at lower-achieving schools.

7. Conclusion

[To come]

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Table 1: Information Shocks, Information Variables and Open Enrolment

School Year	Public information about school achievement	Basis of ranking for information measure ($r_{s\|\Omega(i,t)}$)	Information measure, I_{st}	Open enrolment in effect?
1996/1997	None	n/a	None	No
1997/1998	None	n/a	None	No
1998/1999	None	n/a	None	No
1999/2000	None	n/a	None	No
2000/2001	None	n/a	None	No
2001/2002	1999/2000 school-average FSA scores (released to parents on request in October 2000)	1999/2000 Mean FSA Score	$r_{s\|\Omega(i,2001)}$*(Year=2001)	No
2002/2003	2000/2001 school-average FSA scores (released on Ministry of Education website in October 2001)	2000/2001 Mean FSA Score	$r_{s\|\Omega(i,2002)}$*(Year=2002)	Yes (July 2002)
2003/2004	Fraser Institute (FI) scores and rankings based on 1999/2000, 2000/2001 and 2001/2002 FSA exams (released in June 2003); and 2001/2002 school-average FSA scores (released on Ministry of Education website in October 2002)	2001/2002 Mean FSA Score	$r_{s\|\Omega(i,2003)}$*(Year=2003)	Yes
2004/2005	FI scores and rankings based on 2002/2003 FSA exams (released in June 2004); and 2002/2003 school-average FSA scores (released on Ministry of Education website in October 2003)	2002/2003 Mean FSA Score	$r_{s\|\Omega(i,2004)}$*(Year=2004)	Yes
2005/2006	FI scores and rankings based on 2003/2004 FSA exams (released in June 2005); and 2003/2004 school-average FSA scores (released on Ministry of Education website in October 2004)	2003/2004 Mean FSA Score	$r_{s\|\Omega(i,2005)}$*(Year=2005)	Yes
2006/2007	FI scores and rankings based on 2004/2005 FSA exams (released in June 2006); and 2004/2005 school-average FSA scores (released on Ministry of Education website in October 2005)	2004/2005 Mean FSA Score	$r_{s\|\Omega(i,2006)}$*(Year=2006)	Yes

Sources: see Data Appendix.

Note: Enrolment data are measured as of September 30 each year. Given the release dates of public information about school achievement above, information about achievement on the exam in year t could first have affected enrolments as of September 30 in year t+2.

Table 2. Student Characteristics by Ethnicity and Home Language, Grade 4, 1996-2006.

	Share of Grade 4 Enrolment	Mean Grade 4 Reading Score	Mean Grade 4 Numeracy Score	Proportion Disabled	Proportion Gifted
All	1	0.072	0.134	0.048	0.011
English	0.623	0.175	0.171	0.049	0.013
Chinese	0.113	0.147	0.494	0.024	0.013
Punjabi	0.066	-0.309	-0.166	0.031	0.003
Aboriginal	0.057	-0.291	-0.300	0.135	0.004
Other	0.140	-0.131	-0.006	0.033	0.006
N					

Table 3: Decomposition of the Adjusted Generalized Dissimilarity Index, 1996-2006

	Kindergarten					Grade 4				
		Component of Dissimilarity Index Due to:					Component of Dissimilarity Index Due to:			
Year	**Total**	Residential Sorting	Public out-of-Catchment Enrollment	French Immersion Enrollment	Private Enrollment	**Total**	Residential Sorting	Public out-of-Catchment Enrollment	French Immersion Enrollment	Private Enrollment
1996	**0.415** ***	0.370 ***	0.012 ***	0.005	0.028 ***	**0.409** ***	0.372 ***	0.009 ***	0.003	0.025 ***
1997	**0.416** ***	0.369 ***	0.008 **	0.005	0.034 ***	**0.425** ***	0.385 ***	0.006 *	0.004	0.030 ***
1998	**0.437** ***	0.390 ***	0.011 ***	0.005	0.031 ***	**0.418** ***	0.368 ***	0.007 **	0.004	0.038 ***
1999	**0.454** ***	0.400 ***	0.010 ***	0.007 *	0.037 ***	**0.420** ***	0.374 ***	0.008 ***	0.003	0.035 ***
2000	**0.459** ***	0.408 ***	0.008 **	0.009 ***	0.034 ***	**0.417** ***	0.373 ***	0.004	0.006 *	0.034 ***
2001	**0.470** ***	0.413 ***	0.012 ***	0.008 **	0.037 ***	**0.431** ***	0.385 ***	0.007 **	0.004	0.035 ***
2002	**0.468** ***	0.407 ***	0.011 ***	0.009 ***	0.041 ***	**0.430** ***	0.380 ***	0.007 **	0.006 *	0.038 ***
2003	**0.472** ***	0.407 ***	0.014 ***	0.007 *	0.042 ***	**0.434** ***	0.386 ***	0.010 ***	0.005 *	0.033 ***
2004	**0.471** ***	0.403 ***	0.013 ***	0.014 ***	0.042 ***	**0.439** ***	0.394 ***	0.005 *	0.005 *	0.034 ***
2005	**0.464** ***	0.391 ***	0.021 ***	0.007	0.044 ***	**0.439** ***	0.390 ***	0.009 **	0.007 ***	0.033 ***
2006	**0.471** ***	0.406 ***	0.014 ***	0.011 ***	0.040 ***	**0.443** ***	0.384 ***	0.011 ***	0.010 ***	0.039 ***

Notes: Asterisks summarize the results of the Carrington and Troske (1993) randomization test of the hypothesis that the unadjusted dissimilarity index (or component thereof) is *no greater than* expected dissimilarity under a random distribution of ethno-linguistic types across schools, holding school sizes constant. This corresponds to an adjusted dissimilarity index (or component thereof) less than or equal to zero. * indicates p-value<0.1, ** indicates p-value<0.05, *** indicates p-value<0.01

Table 4: Decomposition of the Adjusted Dissimilarity Index for English Home Language Students, 1996-2006

	Kindergarten					Grade 4				
		Component of Dissimilarity Index Due to:					Component of Dissimilarity Index Due to:			
Year	**Total**	Residential Sorting	Public out-of-Catchment Enrollment	French Immersion Enrollment	Private Enrollment	**Total**	Residential Sorting	Public out-of-Catchment Enrollment	French Immersion Enrollment	Private Enrollment
1996	**0.407** ***	0.357 ***	0.014 ***	0.009 ***	0.028 ***	**0.404** ***	0.361 ***	0.009 **	0.005	0.028 ***
1997	**0.411** ***	0.354 ***	0.012 ***	0.010 ***	0.034 ***	**0.416** ***	0.368 ***	0.010 **	0.006 *	0.032 ***
1998	**0.425** ***	0.366 ***	0.016 ***	0.008 ***	0.035 ***	**0.404** ***	0.346 ***	0.010 **	0.007 ***	0.041 ***
1999	**0.442** ***	0.381 ***	0.010 ***	0.011 ***	0.039 ***	**0.412** ***	0.357 ***	0.009 **	0.006 **	0.040 ***
2000	**0.444** ***	0.381 ***	0.015 ***	0.011 ***	0.037 ***	**0.414** ***	0.362 ***	0.004	0.010 ***	0.038 ***
2001	**0.471** ***	0.402 ***	0.015 ***	0.014 ***	0.041 ***	**0.427** ***	0.371 ***	0.007 **	0.007 ***	0.041 ***
2002	**0.462** ***	0.390 ***	0.011 ***	0.014 ***	0.047 ***	**0.428** ***	0.367 ***	0.007 **	0.009 ***	0.045 ***
2003	**0.464** ***	0.384 ***	0.017 ***	0.013 ***	0.050 ***	**0.430** ***	0.368 ***	0.015 ***	0.009 ***	0.038 ***
2004	**0.462** ***	0.382 ***	0.011 ***	0.020 ***	0.049 ***	**0.433** ***	0.372 ***	0.009 **	0.009 ***	0.042 ***
2005	**0.462** ***	0.374 ***	0.026 ***	0.012 ***	0.050 ***	**0.439** ***	0.382 ***	0.007 *	0.012 ***	0.038 ***
2006	**0.474** ***	0.395 ***	0.017 ***	0.016 ***	0.045 ***	**0.437** ***	0.370 ***	0.009 **	0.015 ***	0.042 ***

Notes: Asterisks summarize the results of the Carrington and Troske (1993) randomization test of the hypothesis that the unadjusted dissimilarity index (or component thereof) is *no greater than* expected dissimilarity under a random distribution of ethno-linguistic types across schools, holding school sizes constant. This corresponds to an adjusted dissimilarity index (or component thereof) less than or equal to zero. * indicates p-value<0.1, ** indicates p-value<0.05, *** indicates p-value<0.01

Table 5: Decomposition of the Adjusted Dissimilarity Index for Chinese Home Language Students, 1996-2006

	Kindergarten					Grade 4				
		Component of Dissimilarity Index Due to:					Component of Dissimilarity Index Due to:			
Year	**Total**	Residential Sorting	Public out-of-Catchment Enrollment	French Immersion Enrollment	Private Enrollment	**Total**	Residential Sorting	Public out-of-Catchment Enrollment	French Immersion Enrollment	Private Enrollment
1996	**0.545** ***	0.514 ***	0.003	0.010	0.018	**0.521** ***	0.504 ***	-0.003	0.009	0.011
1997	**0.566** ***	0.528 ***	0.007	0.010	0.034	**0.559** ***	0.548 ***	-0.007	0.005	0.012
1998	**0.569** ***	0.531 ***	0.006	0.009	0.022 *	**0.554** ***	0.522 ***	0.003	0.006	0.023 ***
1999	**0.580** ***	0.541 ***	0.005	0.010	0.024 **	**0.544** ***	0.504 ***	0.008	0.005	0.027 ***
2000	**0.576** ***	0.543 ***	-0.004	0.012 *	0.025 **	**0.549** ***	0.525 ***	0.004	0.006	0.014
2001	**0.576** ***	0.531 ***	0.005	0.009	0.031 ***	**0.562** ***	0.532 ***	0.000	0.006	0.024 ***
2002	**0.554** ***	0.519 ***	0.008	0.004	0.022 *	**0.549** ***	0.521 ***	0.006	0.008	0.015
2003	**0.565** ***	0.527 ***	0.005	0.003	0.031 ***	**0.555** ***	0.529 ***	0.000	0.005	0.021 ***
2004	**0.575** ***	0.523 ***	0.012	0.009	0.031 ***	**0.567** ***	0.531 ***	0.007	0.004	0.025 ***
2005	**0.551** ***	0.504 ***	0.012	0.002	0.033 ***	**0.564** ***	0.532 ***	0.008	0.003	0.020 **
2006	**0.529** ***	0.500 ***	0.000	0.006	0.023	**0.555** ***	0.515 ***	0.011	0.006	0.023 ***

Notes: Asterisks summarize the results of the Carrington and Troske (1993) randomization test of the hypothesis that the unadjusted dissimilarity index (or component thereof) is *no greater than* expected dissimilarity under a random distribution of ethno-linguistic types across schools, holding school sizes constant. This corresponds to an adjusted dissimilarity index (or component thereof) less than or equal to zero. * indicates p-value<0.1, ** indicates p-value<0.05, *** indicates p-value<0.01

Table 6: Decomposition of the Adjusted Dissimilarity Index for Punjabi Home Language Students, 1996-2006

	Kindergarten					Grade 4				
		Component of Dissimilarity Index Due to:					Component of Dissimilarity Index Due to:			
Year	**Total**	Residential Sorting	Public out-of-Catchment Enrollment	French Immersion Enrollment	Private Enrollment	**Total**	Residential Sorting	Public out-of-Catchment Enrollment	French Immersion Enrollment	Private Enrollment
1996	**0.588** ***	0.546 ***	0.014	0.002	0.026	**0.579** ***	0.537 ***	0.017 *	0.000	0.025
1997	**0.638** ***	0.567 ***	0.018 *	0.004	0.034 ***	**0.589** ***	0.530 ***	0.027 **	-0.003	0.034 **
1998	**0.628** ***	0.601 ***	0.005	0.003	0.019	**0.577** ***	0.539 ***	0.011	-0.001	0.029 *
1999	**0.647** ***	0.613 ***	0.008	0.002	0.023	**0.586** ***	0.553 ***	0.009	0.001	0.023
2000	**0.658** ***	0.614 ***	0.007	0.006	0.030 **	**0.585** ***	0.547 ***	0.013	0.001	0.024
2001	**0.663** ***	0.619 ***	0.007	0.006	0.031 **	**0.638** ***	0.600 ***	0.014 *	0.002	0.023
2002	**0.677** ***	0.628 ***	0.010	0.008	0.030 **	**0.632** ***	0.608 ***	-0.001	0.005	0.020
2003	**0.694** ***	0.651 ***	0.013	0.006	0.023	**0.648** ***	0.618 ***	0.008	0.001	0.021
2004	**0.692** ***	0.643 ***	0.015 *	0.009	0.025	**0.644** ***	0.611 ***	0.008	0.003	0.023 *
2005	**0.696** ***	0.636 ***	0.018 **	0.006	0.035 ***	**0.646** ***	0.608 ***	0.010	0.003	0.024 *
2006	**0.706** ***	0.658 ***	0.013	0.004	0.031 **	**0.683** ***	0.631 ***	0.018 **	0.002	0.032 ***

Notes: Asterisks summarize the results of the Carrington and Troske (1993) randomization test of the hypothesis that the unadjusted dissimilarity index (or component thereof) is *no greater than* expected dissimilarity under a random distribution of ethno-linguistic types across schools, holding school sizes constant. This corresponds to an adjusted dissimilarity index (or component thereof) less than or equal to zero. * indicates p-value<0.1, ** indicates p-value<0.05, *** indicates p-value<0.01

Table 7: Decomposition of the Adjusted Dissimilarity Index for Aboriginal Students, 1996-2006

	Kindergarten					Grade 4				
		Component of Dissimilarity Index Due to:					Component of Dissimilarity Index Due to:			
Year	**Total**	Residential Sorting	Public out-of-Catchment Enrollment	French Immersion Enrollment	Private Enrollment	**Total**	Residential Sorting	Public out-of-Catchment Enrollment	French Immersion Enrollment	Private Enrollment
1996	**0.211** ***	0.189 ***	0.014 *	-0.008	0.015 *	**0.254** ***	0.212 ***	0.020 **	0.002	0.019 **
1997	**0.157** ***	0.173 ***	-0.014	-0.009	0.034	**0.240** ***	0.239 ***	-0.010	-0.005	0.017 *
1998	**0.213** ***	0.190 ***	0.003	-0.001	0.020 **	**0.253** ***	0.238 ***	0.002	-0.003	0.016 *
1999	**0.192** ***	0.187 ***	-0.003	-0.006	0.015	**0.250** ***	0.216 ***	0.016 **	0.002	0.017 *
2000	**0.246** ***	0.226 ***	0.000	0.005	0.015	**0.241** ***	0.221 ***	0.006	-0.005	0.018 **
2001	**0.245** ***	0.226 ***	0.008	-0.003	0.014	**0.239** ***	0.209 ***	0.012 *	-0.001	0.020 **
2002	**0.256** ***	0.229 ***	0.009	0.000	0.018	**0.258** ***	0.201 ***	0.032 ***	-0.002	0.027 ***
2003	**0.278** ***	0.232 ***	0.019 *	0.005	0.023 *	**0.265** ***	0.254 ***	0.002	-0.003	0.012
2004	**0.297** ***	0.249 ***	0.024 **	0.006	0.018	**0.265** ***	0.249 ***	0.003	0.000	0.013
2005	**0.305** ***	0.262 ***	0.024 **	-0.001	0.020	**0.292** ***	0.241 ***	0.023 **	0.003	0.026 ***
2006	**0.297** ***	0.247 ***	0.016	0.002	0.031 **	**0.295** ***	0.230 ***	0.036 ***	0.005	0.024 **

Notes: Asterisks summarize the results of the Carrington and Troske (1993) randomization test of the hypothesis that the unadjusted dissimilarity index (or component thereof) is *no greater than* expected dissimilarity under a random distribution of ethno-linguistic types across schools, holding school sizes constant. This corresponds to an adjusted dissimilarity index (or component thereof) less than or equal to zero. * indicates p-value<0.1, ** indicates p-value<0.05, *** indicates p-value<0.01

Table 8: Decomposition of Variance of Grade 4 Test Scores, 1999-2006

	Reading			Numeracy		
Year	Within-school variation	Between-school Variation	Total	Within-school variation	Between-school Variation	Total
1999	0.861	0.122	0.984	0.842	0.159	1.001
2000	0.876	0.124	0.999	0.868	0.132	1.000
2001	0.866	0.138	1.001	0.837	0.164	1.001
2002	0.869	0.141	1.006	0.841	0.162	1.000
2003	0.845	0.157	0.999	0.818	0.185	1.001
2004	0.849	0.161	1.004	0.807	0.200	1.003
2005	0.856	0.146	1.000	0.832	0.177	1.002
2006	0.853	0.154	1.004	0.789	0.215	1.000

Table 9: Effects of Open Enrolment on School-level Index of Generalized Dissimilarity

	(1)	(2)	(3)	(4)
Panel 1: Kindergarten				
Private Competition	-0.001	-0.001	0.004	0.006
	(0.004)	(0.004)	(0.007)	(0.007)
Public Competition	-0.017**	-0.017**	0.010	0.011
	(0.008)	(0.008)	(0.010)	(0.010)
Open Enrolment * Private Competition	-0.001	0.001	-0.001	0.000
	(0.001)	(0.002)	(0.001)	(0.002)
Open Enrolment * Public Competition	-0.002	-0.005	0.000	-0.001
	(0.005)	(0.005)	(0.004)	(0.004)
t-1 School-average test score	0.110***	0.112***	0.005	0.015
	(0.024)	(0.023)	(0.020)	(0.022)
Open Enrolment * t-1 School-average test score	-0.047**	-0.084***	-0.032	-0.047**
	(0.023)	(0.025)	(0.021)	(0.023)
Panel 2: Grade 4				
Private Competition	-0.006*	-0.006	0.002	0.001
	(0.004)	(0.004)	(0.004)	(0.005)
Public Competition	-0.030***	-0.029***	-0.006	-0.005
	(0.006)	(0.006)	(0.008)	(0.008)
Open Enrolment * Private Competition	0.001	0.002	0.001	0.002
	(0.001)	(0.001)	(0.001)	(0.001)
Open Enrolment * Public Competition	0.006*	0.004	0.007***	0.005*
	(0.003)	(0.004)	(0.003)	(0.003)
t-1 School-average test score	0.106***	0.098***	0.024	0.021
	(0.024)	(0.024)	(0.017)	(0.018)
Open Enrolment * t-1 School-average test score	-0.053**	-0.067***	-0.041**	-0.036*
	(0.022)	(0.025)	(0.018)	(0.020)
Fixed District Effects	YES	YES		
Fixed Year Effects	YES	YES	YES	YES
Neighborhood Characteristics	YES	YES	YES	YES
Fixed School Effects			YES	YES
Information Measures		YES		YES

Notes: Estimates are based on equation (6). For each school-year, Private Competition measures the average number of private schools in the local choice set of students in the school's travel circle; and Public Competition is the average number of public schools in the local choice set of students in the school's travel circle. Open Enrolment is an indicator for school year 2002 and later. Information measures are the school's test score ranking against the other schools in the average student's local choice set. Observations are weighted by 2001 enrolment. French Immersion schools and schools without 2001 enrollment data are excluded. Standard errors are in parentheses. *** p<0.01, ** p<0.05,

Table 10: Effects of Open Enrolment on School Enrolment Levels

	(1)	(2)	(3)	(4)
Panel 1: Kindergarten				
Private Competition	0.800*	0.747*	0.033	-0.036
	(0.410)	(0.414)	(0.379)	(0.383)
Public Competition	-0.044	0.068	-3.054***	-2.999***
	(0.600)	(0.583)	(0.507)	(0.513)
Open Enrolment * Private Competition	-0.204*	-0.220*	-0.191**	-0.150*
	(0.118)	(0.122)	(0.076)	(0.079)
Open Enrolment * Public Competition	0.536	0.718**	0.527**	0.467**
	(0.336)	(0.351)	(0.205)	(0.212)
t-1 School-average test score	-5.908**	-5.523**	-4.003***	-3.768***
	(2.588)	(2.439)	(1.065)	(1.124)
Open Enrolment * t-1 School-average test score	6.552***	5.608***	7.100***	6.430***
	(1.870)	(2.088)	(1.088)	(1.211)
Panel 2: Grade 4				
Private Competition	-0.052	-0.132	0.367	0.327
	(0.370)	(0.380)	(0.279)	(0.283)
Public Competition	-0.477	-0.315	-2.101***	-2.123***
	(0.572)	(0.568)	(0.520)	(0.523)
Open Enrolment * Private Competition	0.204*	0.205*	0.145**	0.157**
	(0.110)	(0.117)	(0.070)	(0.073)
Open Enrolment * Public Competition	0.093	0.198	0.116	0.121
	(0.307)	(0.335)	(0.169)	(0.182)
t-1 School-average test score	1.325	0.826	-1.166	-1.157
	(2.647)	(2.430)	(1.086)	(1.150)
Open Enrolment * t-1 School-average test score	-0.593	-0.302	1.806	1.913
	(1.860)	(1.987)	(1.111)	(1.241)
Fixed District Effects	YES	YES		
Fixed Year Effects	YES	YES	YES	YES
Neighborhood Characteristics	YES	YES	YES	YES
Fixed School Effects			YES	YES
Information Measures		YES		YES

Notes: Estimates are based on equation (6). For each school-year, Private Competition measures the average number of private schools in the local choice set of students in the school's travel circle; and Public Competition is the average number of public schools in the local choice set of students in the school's travel circle. Open Enrolment is an indicator for school year 2002 and later. Information measures are the school's test score ranking against the other schools in the average student's local choice set. Observations are weighted by 2001 enrolment. French Immersion schools and schools without 2001 enrollment data are excluded. Standard errors are in parentheses. *** p<0.01, ** p<0.05,

Table 11: Effects of Open Enrolment on School-Average Grade 4 Test Scores

	(1)	(2)	(3)	(4)
Panel 1: Reading				
Private Competition	-0.007***	-0.007**	0.006	0.006
	(0.003)	(0.003)	(0.007)	(0.007)
Public Competition	-0.010*	-0.009*	-0.002	-0.003
	(0.005)	(0.005)	(0.013)	(0.013)
Open Enrolment * Private Competition	0.001	0.002	0.001	0.000
	(0.002)	(0.002)	(0.002)	(0.002)
Open Enrolment * Public Competition	0.009**	0.010**	0.008**	0.006
	(0.004)	(0.004)	(0.004)	(0.005)
t-1 School-average test score	0.520***	0.475***	0.067**	0.047*
	(0.040)	(0.041)	(0.027)	(0.029)
Open Enrolment * t-1 School-average test score	-0.023	-0.064	-0.026	0.014
	(0.038)	(0.043)	(0.028)	(0.031)
Panel 2: Numeracy				
Private Competition	-0.006*	-0.005	0.013	0.015*
	(0.003)	(0.003)	(0.009)	(0.009)
Public Competition	-0.020***	-0.019***	-0.036**	-0.037**
	(0.007)	(0.006)	(0.016)	(0.016)
Open Enrolment * Private Competition	0.006***	0.008***	0.005**	0.005**
	(0.002)	(0.002)	(0.002)	(0.002)
Open Enrolment * Public Competition	0.013*	0.014**	0.013**	0.010*
	(0.006)	(0.007)	(0.005)	(0.006)
t-1 School-average test score	0.560***	0.505***	0.075**	0.055
	(0.049)	(0.051)	(0.033)	(0.035)
Open Enrolment * t-1 School-average test score	0.067	0.005	0.043	0.076**
	(0.050)	(0.054)	(0.034)	(0.038)
Fixed District Effects	YES	YES		
Fixed Year Effects	YES	YES	YES	YES
Neighborhood Characteristics	YES	YES	YES	YES
Fixed School Effects			YES	YES
Information Measures		YES		YES

Notes: Estimates are based on equation (6). For each school-year, Private Competition measures the average number of private schools in the local choice set of students in the school's travel circle; and Public Competition is the average number of public schools in the local choice set of students in the school's travel circle. Open Enrolment is an indicator for school year 2002 and later. Information measures are the school's test score ranking against the other schools in the average student's local choice set. Observations are weighted by 2001 enrolment. French Immersion schools and schools without 2001 enrollment data are excluded. Standard errors are in parentheses. *** p<0.01, ** p<0.05,

Table 12: Effects of Open Enrolment on Within-School Variance of Grade 4 Test Scores

	(1)	(2)	(3)	(4)
Panel 1: Reading				
Private Competition	-0.000	-0.001	-0.006	-0.006
	(0.002)	(0.002)	(0.006)	(0.007)
Public Competition	0.005	0.005	0.006	0.003
	(0.004)	(0.004)	(0.012)	(0.012)
Open Enrolment * Private Competition	-0.002	-0.002	-0.002	-0.002
	(0.002)	(0.002)	(0.002)	(0.002)
Open Enrolment * Public Competition	0.000	0.003	-0.000	0.002
	(0.004)	(0.004)	(0.004)	(0.004)
t-1 School-average test score	0.033	0.058**	0.008	0.023
	(0.025)	(0.029)	(0.025)	(0.026)
Open Enrolment * t-1 School-average test score	-0.066**	-0.088***	-0.065**	-0.075***
	(0.028)	(0.032)	(0.026)	(0.029)
Panel 2: Numeracy				
Private Competition	-0.002	-0.002	-0.004	-0.005
	(0.002)	(0.003)	(0.007)	(0.007)
Public Competition	-0.000	-0.001	-0.007	-0.008
	(0.005)	(0.005)	(0.013)	(0.013)
Open Enrolment * Private Competition	0.001	0.001	0.001	0.000
	(0.002)	(0.002)	(0.002)	(0.002)
Open Enrolment * Public Competition	-0.001	0.003	-0.001	0.001
	(0.005)	(0.005)	(0.004)	(0.004)
t-1 School-average test score	0.072**	0.082**	0.004	0.007
	(0.031)	(0.035)	(0.027)	(0.028)
Open Enrolment * t-1 School-average test score	-0.018	-0.042	-0.022	-0.020
	(0.031)	(0.036)	(0.027)	(0.031)
Fixed District Effects	YES	YES		
Fixed Year Effects	YES	YES	YES	YES
Neighborhood Characteristics	YES	YES	YES	YES
Fixed School Effects			YES	YES
Information Measures		YES		YES

Notes: Estimates are based on equation (6). For each school-year, Private Competition measures the average number of private schools in the local choice set of students in the school's travel circle; and Public Competition is the average number of public schools in the local choice set of students in the school's travel circle. Open Enrolment is an indicator for school year 2002 and later. Information measures are the school's test score ranking against the other schools in the average student's local choice set. Observations are weighted by 2001 enrolment. French Immersion schools and schools without 2001 enrollment data are excluded. Standard errors are in parentheses. *** p<0.01, ** p<0.05,

Figure 1: Ethnolingusitic Composition of Kindergarten Students, 1996-2006

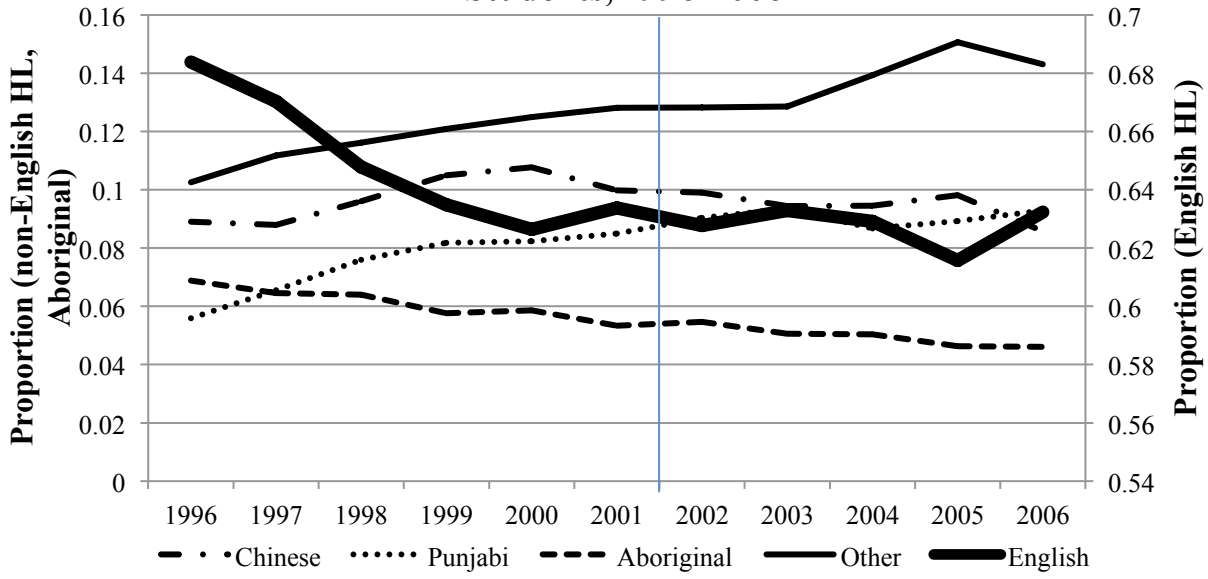


Figure 2: Kindergarten Enrolment, 1996-2006

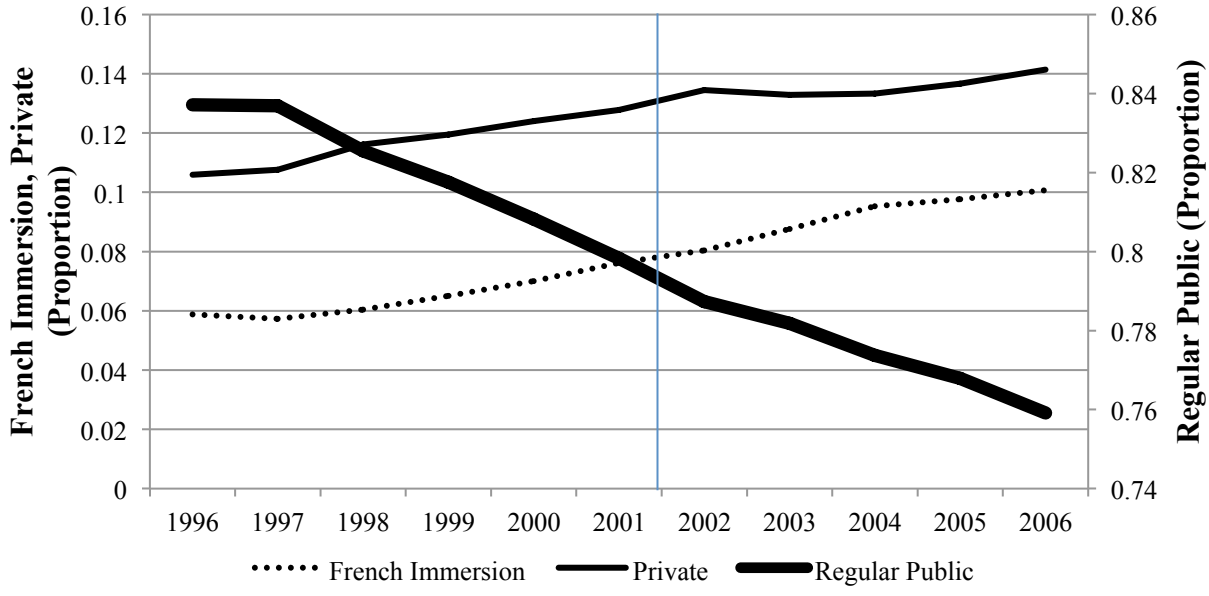


Figure 3: Kindergarten Enrolment, 1996-2006

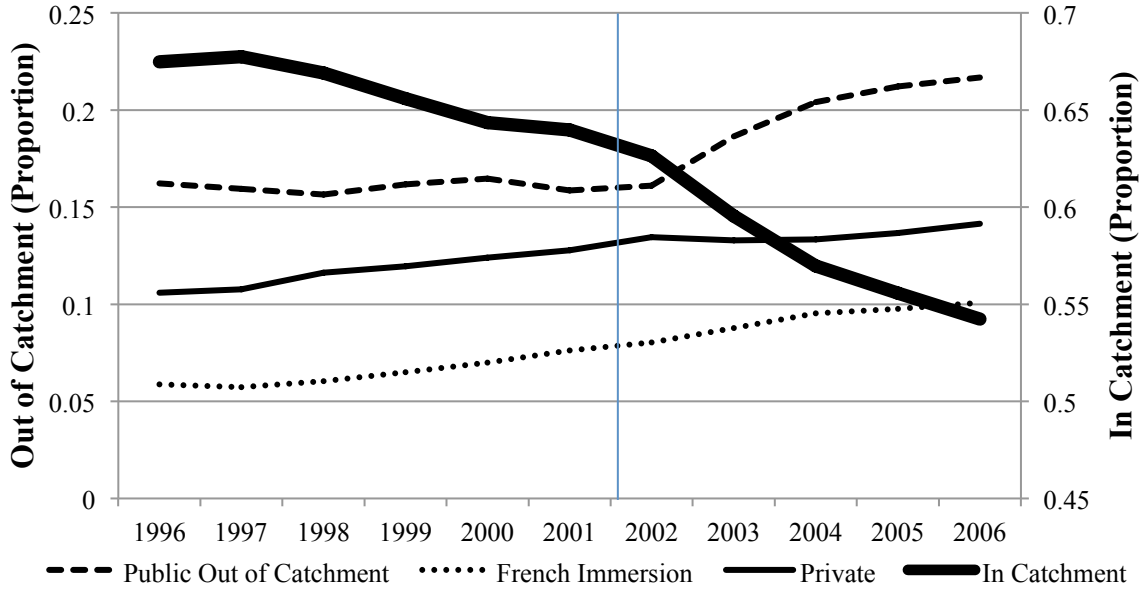


Figure 4: Public Out-of-Catchment Enrolment, 1996-2006

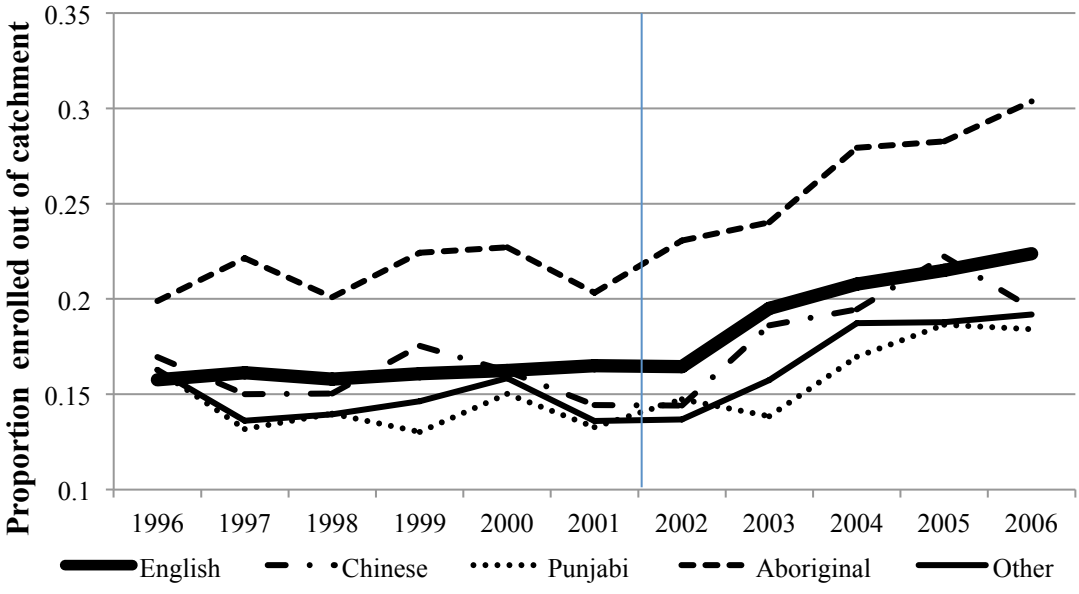


Figure 5: Private School Enrolment, 1996-2006

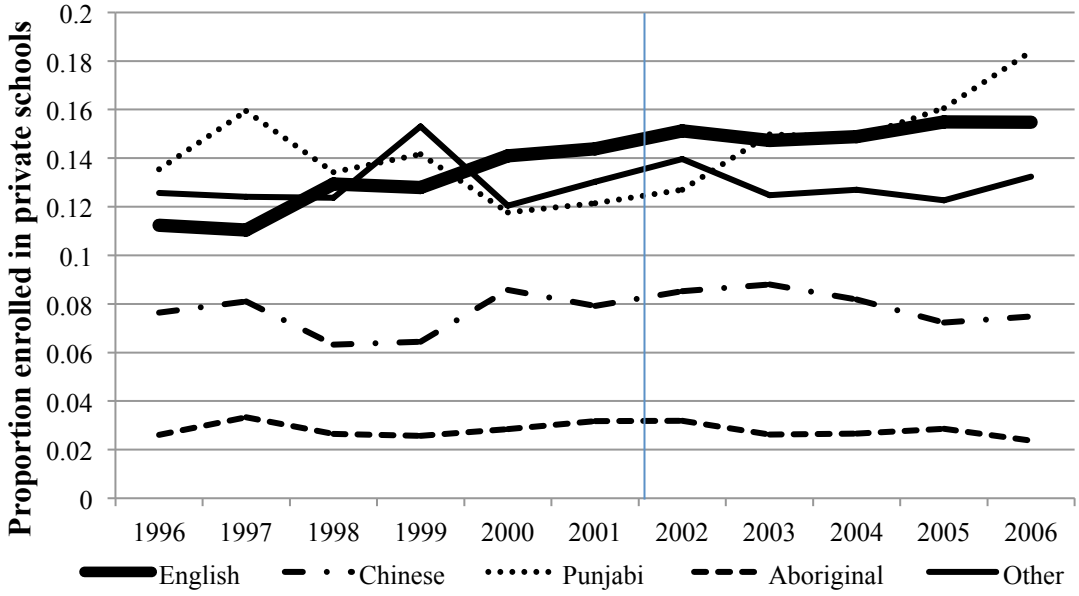


Figure 6: French Immersion Enrolment, 1996-2006

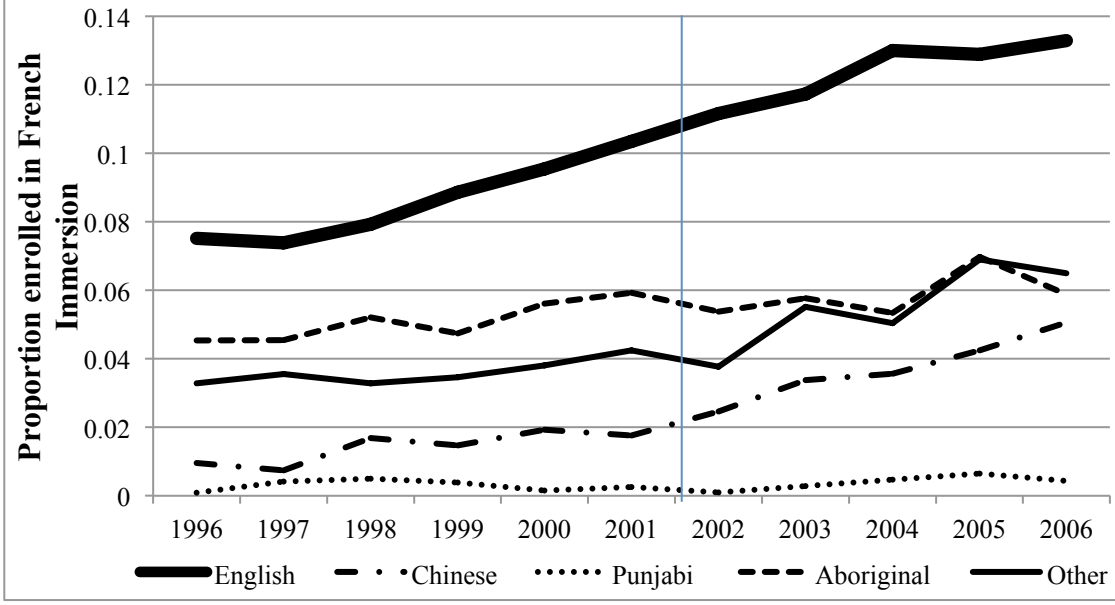


Figure 7: Public In-Catchment Enrolment, 1996-2006

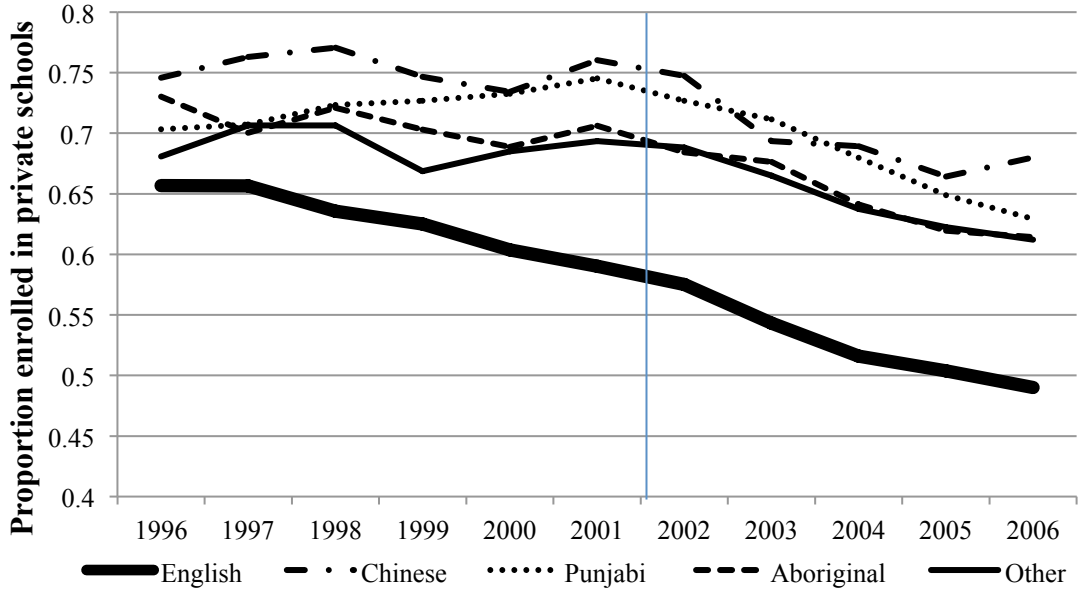
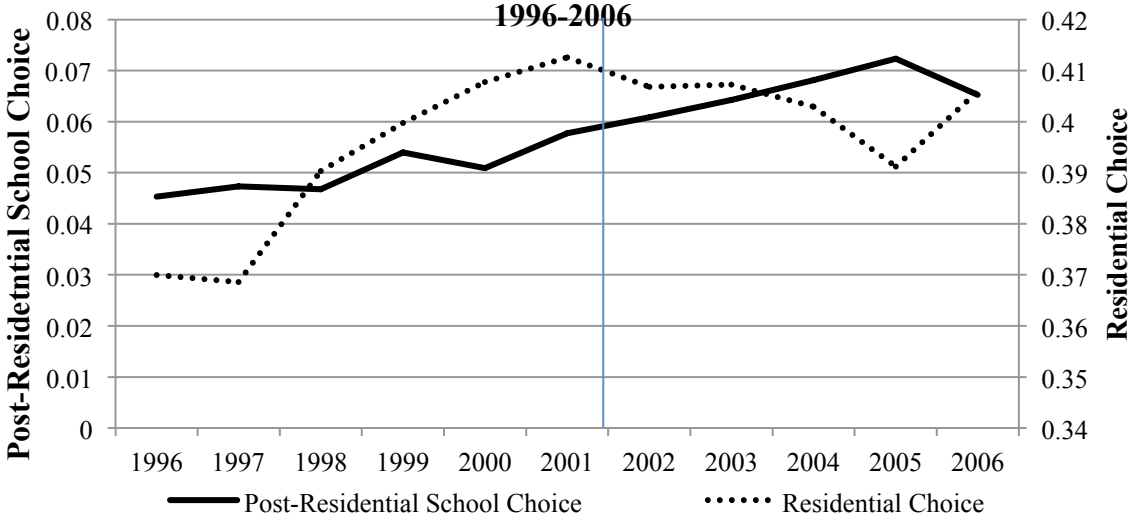


Figure 8: Contribution of Residential Choice and Post-Residential School Choice to Adjusted Generalized Dissimilarity Index, 1996-2006



Note: Series labeled Post-Residential School Choice is the sum of contributions of public out-of-catchment enrolment, French Immersion enrolment, and private school enrolment to the adjusted generalized dissimiliarity index.