# Middle School or Junior High?
# How Grade Level Configurations Affect Academic Achievement

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Elizabeth Dhuey
Centre for Industrial Relations and Human Resources
Department of Management
University of Toronto
121 St. George Street
Toronto, Ontario, M5S 2E8 Canada
416.978.2721
elizabeth.dhuey@utoronto.ca

Abstract

Does the grade level configuration of a school affect student achievement? Despite being a popular education reform, little research exists regarding the effect of grade level configurations. This research examines the effect of attending a middle or junior high school on academic outcomes in British Columbia relative to attending a school from kindergarten through 8th grade. Using an OLS strategy, I find that attending a middle or junior high school reduces grade 4 to 7 achievement gains in math by 0.125–0.187. Smaller but still economically significant effects are found for reading achievement. Similar sized estimates are found for math using a two stage least squares estimation strategy. In addition, students on the bottom half of the ability distribution are affected the most by attending a middle or junior high school. Finally, large negative effects on grade 10 and grade 12 English exams are also found.

## I. Introduction

Does the grade level configuration of a school affect student achievement? What constitutes a “standard” configuration has changed many times over the past century, and the current push is to merge middle and junior high schools with their elementary counterparts to create kindergarten through 8th grade schools (Schwartz et al. 2011). This paper examines the effect of different grade level configurations on student achievement in British Columbia, Canada, by testing whether students who attend a middle or junior high school have different academic achievement gains than do students who attend one school from kindergarten until the beginning of high school.

Understanding the impact of grade level configuration on academic achievement is important, as rearranging grade level configurations within schools may be a comparatively inexpensive policy lever compared to other school reforms, and it is something over which individual districts often have control. Grade level configuration may have an effect on student achievement as it can impact schools’ practices and policies such as curriculum development and delivery. It can also have an effect on school and cohort size, and it determines the number and timing of structural transitions a student takes during his or her educational career. Finally, it can affect peer composition and age distribution within schools. All of these factors can greatly influence student achievement, yet despite the extensive research that has been conducted on other factors that may affect achievement growth—such as teacher quality, class size, and school resources—very little attention has been paid to the effect of grade level configurations.

During the early 1900s in the United States, education reformers experimented with splitting the elementary school grades into two school types, one for the early elementary grades and one for the later grades, termed junior high school. Educators during that time believed that the kindergarten through 8th grade schooling structure was unsupported by psychological research and ignored the developmental needs of the students (Fleming and Toutant 1995). The creation of junior high schools in Canada generally lagged behind the United States by more than a decade. However, by 1920, two junior high schools had opened in the country - one in Winnipeg, Manitoba, and one in Edmonton, Alberta (Johnson 1968). British Columbia's first junior high school, which served grades 7 through 9, opened in Penticton, in 1926 (Fleming and Toutant 1995). By 1950, many junior high schools existed in British Columbia, and over 5000 junior high schools existed in the United States (Lounsbury 1960). Despite the popularity of this trend, the British Columbia Ministry of Education later decided to return grade 7 to the elementary system, and during the 1950s reorganized all provincial schools into three groups: kindergarten through 7th grade schools, 8th through 10th grade schools, and 11th through 12th grade schools. However, even after this reorganization the debate continued in British Columbia regarding the "best" grade level configuration. In the 1960s, education reformers began to advocate for middle schools—i.e., schools that started in 6th grade. By the 1980s, many middle schools existed in British Columbia. Currently, local school districts in British Columbia are allowed to determine the nature of the grade level configurations in their own district. However, the British Columbia Ministry of Education does not officially recognize institutions as middle or junior high schools.[1]

I use panel data from the province of British Columbia, which has a variety of grade level configurations by district and within districts, to measure the effects of alternative grade level configurations on a variety of measures of academic achievement. Approximately 16 percent of students in British Columbia attend a middle school that begins in 6th grade, and another 16

[1] Middle school refers to a school that starts in 6th grade, and junior high school refers to a school that starts in 7th grade.

percent of students attend a junior high school that begins in 7th grade. Therefore, about 32 percent of students attend a stand-alone middle or junior high school, and the other 68 percent attend a school whose grades extend through 7th grade and higher. I find that 7th grade math and reading scores are significantly negatively affected by middle or junior high school attendance. Specifically, using an ordinary least squares estimation strategy, I find that math scores of students who attended a middle or junior high school were between 0.125–0.187 standard deviations lower than students who attended a kindergarten through 7th grade or higher school, and reading scores were 0.055–0.108 standard deviations lower. In addition, the effect was similar between students who entered in a middle school in 6th grade and students who entered a junior high school in 7th grade. I also find that students who attended a middle or junior high school scored 0.039-0.085 standard deviations lower in 10th and 12th grade English exams.

The choice to attend middle or junior high school in upper elementary grade levels may be endogenous and may be related to unobservable time-varying factors. Therefore, following Rockoff and Lockwood (2010), I construct an instrumental variable using the terminal grade of the school the student attended in 4th grade for middle or junior high school entry. The subsequent results using a two-stage least squares regression strategy find that students who attended middle or junior high school scored 0.116–0.215 standard deviations lower in 7th grade math exams, and 0.088-0.118 standard deviations lower in 10th grade English exams, than the students who did not.

I find that students on the bottom half of the test score distribution were disproportionately negatively affected by attending a middle or junior high school  but I find no relationship between the effect of grade level configuration and gender, special education status, being aboriginal, or being a student with English as a second language. I also find little relationship between the characteristics of the district, such as size and being in a rural area, and the estimates finding students who attended middle or junior high school score lower in math.

## II. Related Literature

Relatively few studies have examined the impact of grade level configuration on student achievement, despite its potential importance. Earlier education work used cross-sectional data to examine this issue, and generally found that there was a relationship between attending middle or junior high school and lower academic performance.[2] Due to the cross-sectional nature of the data, these studies were unable to conclude whether these differences were due to differences in grade level configurations or due to differences in student characteristics across these different configurations.

More recent work by Cook et al. (2008) and Weiss and Kipnes (2006) examined non-academic outcomes such as suspensions, school safety, and self-esteem. They found lower levels of self-esteem and perceived school safety, and higher levels of student misconduct among students who attended middle schools.

The research most relevant to this study includes Bedard and Do (2005), Schwartz et al. (2011), and Rockoff and Lockwood (2010). All three examine the effect of grade level configuration using longitudinal data. Bedard and Do (2005) estimated the effect on on-time high school graduation of moving from a junior high school system, where students stay in elementary school longer, to a middle school system. They found that moving to a middle school system decreases on-time high school graduation by 1–3 percent. Rockoff and Lockwood (2010) used a two-stage least squares approach and Schwartz et al. (2011) used an ordinary least squares

[2] See, for example, Alspaugh 1998a,b; Byrnes and Ruby 2007; Franklin and Glascock 1998; Wihry, Coladarci, and Meadow 1992.

approach using the same longitudinal data from New York City. Both found that moving students from elementary to middle school in 6th or 7th grade causes significant drops in both math and English test scores.

Using an instrumental variables estimation strategy similar to Rockoff and Lockwood (2010), this paper explores the issue of middle and junior high schools in a Canadian context. In addition, this paper uses longitudinal data from an entire province versus a single city. This is an important exercise as New York City has a unique educational environment, and results from that city may not be generalizable to other settings and locations. For instance, unlike New York City, British Columbia has a wide variety of urban and rural schools over a very large geographic area. In addition, the per pupil funding in New York is approximately twice as large as the per pupil funding in British Columba. These along with many other institutional differences make it important to examine the effect of grade level configurations in British Columbia. In addition, I am able to explore longer run outcomes and examine whether attending middle or junior high school causes students to perform differently in high school.

## III. Methodology

The main analysis uses a value-added specification of achievement growth in math and reading from grade 4 to grade 7. This strategy uses the variation of grade level configurations across the province of British Columbia to estimate the effect on student achievement gains of attending a middle or junior high school. The initial estimation strategy is as follows:

$$y_{ist}^{7} = \beta_0 + \beta_1 y_{ist}^{4} + \beta_2 \mathrm{M}_i + x_{it}^{'}\beta_3 + s_{st}^{'}\beta_4 + c_{st}^{'}\beta_5 + \varepsilon_{ist} \qquad (1)$$

where $y_{ist}^{7}$ is the grade 7 math or reading score for student *i,* in school *s,* in year *t*; $y_{ist}^{4}$ is the student's corresponding grade 4 score; $\mathrm{M}_i$ is an indicator equal to one if the student changed from an elementary school to a middle or junior high school between grade 4 and grade 7; $x_{it}^{'}$ is a vector of student-level demographic characteristics, $s_{st}^{'}$ is a vector of school-level characteristics, and $c_{st}^{'}$ is a vector of community-level characteristics; and $\varepsilon_{ist}$ is an idiosyncratic error term.[3] In addition, some specifications will include city or district fixed effects because middle/junior high school geographic locations may not be orthogonal to unobserved factors. Therefore, the city or district fixed effects force the identifying variation to come from within a particular city or district. Other specifications that allow for differences in the effect based on whether the student attended a middle or junior high school will be explored in Section V, Part B.

The coefficient of interest is $\beta_2$, which measures the differential effect on a student's test score growth of attending a middle or junior high school compared to staying in an elementary school from kindergarten through 7th grade or higher.[4] This coefficient measures whether the trajectories of student achievement from grade 4 to grade 7 for students entering middle and junior high schools are different than for students who never attended a middle or junior high school.

An ordinary least squares identification strategy may not produce causal estimates because the choice to attend a middle or junior high school in upper elementary grades may be related to time-varying factors that are unobservable. For instance, a student who is currently in a

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[3] Because this model includes a lagged dependent variable, $\beta_2$ may be biased downwards and may be interpreted as a lower bound (see Angrist and Pischke, 2009 and Andrabi et al., 2011). In theory, this bias could be corrected by applying the dynamic panel methods of Arellano and Bond (1991), Arellano and Bover (1995) or Blundell and Bond (1998), but in this data it is not possible to apply these methods due to only having two periods of time.

[4] Student test scores are often considered to be measured with error which may attenuate the coefficient on the lagged dependent variable and may bias the coefficient on middle/junior high school in an undetermined direction. However, Andrabi et al. (2011) notes that, "correcting for measurement error alone may be worse than doing nothing." These authors are referring to the fact that because I am unable to correct for the bias from including the lagged dependent variable (because my data only includes two periods), it is wise for me to not correct for measurement error. However, all estimates using the math test scores as an instrument for reading test scores or using reading test scores as an instrument for math test scores are not substantively different than the estimates presented in this paper and are available upon request from the author.

kindergarten through 7th grade school may move to a middle school in 6th grade due to unobservable factors related to achievement such as a residential move or a family disruption. However, generally, school choice is based on residential location.[5] But in cases where there is an endogenous move, the ordinary least squares estimate would not be able to untangle the effect of moving to middle school from the effect of these factors.

Therefore, following Rockoff and Lockwood (2010), I created an instrument for middle or junior high school entry using the grade level configuration of the school attended in grade 4. If the student attends a school that ends in grade 5 or grade 6 when they are in grade 4, I create an indicator variable that indicates the student should enter a middle or junior high school in grade 6 or 7.[6] A threat to the validity of this instrument would be if the configuration of the school attended in grade 4 is related to something unobserved that affects test score growth from grade 4 to grade 7 that is not controlled for by the inclusion of the grade 4 test score along with the large quantity of student, school, and community characteristics. The estimates produced using this estimation strategy can be interpreted as local average treatment effects.[7] The estimates apply to students who are induced to move into a middle or junior high school because they attended a school ending in grade 5 or 6. This may be different than the average treatment effect.

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[5] Prior to 2003 in British Columbia, students were guaranteed a place at their neighbourhood public school, but could apply to enroll in a school in a different catchment area with the permission of both the neighbourhood school and the new school. Since 2003, the province introduced legislation allowing parents' the ability to send their children to any public school that had space available after students living in the catchment area have enrolled. However, Smith and DeCicca (2011) state that this has not been very successful in creating public school choice in British Columbia.

[6] Some schools changed their grade level configuration during this sample period. Therefore, the instrument reflects these changes when they occur. In addition, in Section V, Part B, the analysis is broken up into whether the student attended a middle school versus a junior high school. Therefore, one instrument was created for students in 4th grade whose school ended in 5th grade, and another instrument was created for students in 4th grade whose school ended in 6th grade.

[7] Monotonicity is required to allow for this interpretation. In this case, the behavior that would violate monotonicity is if a student a) attends a middle/junior high school when they are not expected to, given their 4th grade configuration; and b) does not attend a middle/junior high school when they are expected to, based on their 4th grade configuration. Unfortunately, this assumption is untestable but in this circumstance seems reasonable.

In addition to the main analysis, I also examine a few longer run academic outcomes using the following estimation strategy.

$$O_{ist} = \delta_0 + \delta_1 y_{ist}^4 + \delta_2 \mathrm{M}_i + x_{it}^{'} \delta_3 + s_{st}^{'} \delta_4 + c_{st}^{'} \delta_5 + \nu_{ist} \qquad (2)$$

In these cases, $O_{ist}$ is one of the following outcomes: 10th grade mandatory provincial English exam, 12th grade mandatory provincial English exam, high school graduation, and high school grade point average conditional on graduation. The rest of the variables are the same as in equation (1).[8] In these specifications, $\delta_2$, which measures the differential effect on these outcomes of attending a middle or junior high school compared to staying in an elementary school from kindergarten through 7th grade or higher.

A possible concern with this analysis is the potential for non-random attrition from public schools in British Columbia. This could cause a bias in an unknown direction. Only 10 percent of students in British Columbia attend private schools, but it is possible that a high-achieving child who was initially sent to a school that ended in 5th or 6th grade may be sent to a private middle school. It is also equally possible that a child who was low-achieving during the early elementary years may be sent to a private middle school. Therefore, in this short run analysis, a balanced panel of students who were in the public school system in British Columbia in both 4th and 7th grade is used. Hence, the interpretation of the results pertains only to those students. However, in Section V.D., I will further explore the possible effects of attrition bias in this analysis.

[8] 95.3% of students will have transitioned to a high school by grade 10. Including an indicator variable for the approximately five percent of students who have not transitioned does not affect the results.

## IV. Data and Analysis Sample

### *A. Data Sources*

The main datasets used in this study were four linked files obtained from the Ministry of Education in British Columbia. The first contains observations on all students writing the Foundation Skills Assessment, an annual low-stakes standardized test in the areas of mathematics, reading, and writing for students in grades 4 and 7. Data from 1999 through 2006 was used. For these students, the percentage score on each test, the school in which the test was written, and whether the student was excused from the test are known. [9] Student scores are linked over time via an encrypted student identifier. The second file contains data on these student's 10th grade and 12th grade English exams, on whether or not they graduated from high school, and on what their grade point average was at the time of high school graduation conditional on graduating from high school. This file is linked via encrypted student identifiers to the first file.

Student test scores and outcomes are linked via the student identifier to the third file, which contains the administrative records of all public school students in British Columbia from 1999–2006 in grades 4 to 7. These data include demographic information such as gender, aboriginal status, date of birth, and home language, along with information on whether they participate in special education or English as a second language (ESL) programs. Finally, the 6-digit postal code of their home residence is included. In urban areas, this is a very small area consisting sometimes of one side of a city block. In less-populated areas, it can coincide with part or all of a town.

The fourth file contains information on all public schools in British Columbia. For each school, the following are known: which grades are offered, the number of teachers, whether school is standard or other type, and the year of opening and/or closing. Each school's exact address and postal code are included, which give its precise location.

[9] Students with poor English abilities and some students with severe disabilities are excused from writing provincial exams.

Data from the Canada Census is appended to this main set of files. To proxy for student-level socioeconomic status characteristics (SES), various census variables at the Dissemination/Enumeration Area (DA) level are attached using the students' residential postal codes.[10] DAs are relatively small areas designed to contain roughly 400–700 people, and as such act as a reasonable proxy for a student's SES characteristics. Information on household income, education levels, unemployment rates, ethnic and immigrant composition, and the age distribution of each DA is attached to the data.

Therefore, the demographic, school, and community control variables included in the analysis are dummy variables for whether the student is male, aboriginal, ESL, in special education, or has moved schools. Also included is the school's percentage of male students, aboriginal students, ESL students, special education students, students excused from the math test, and students excused from the reading test. In addition, the teacher–pupil ratio and whether the school is in a rural location are included. Finally, the census DA-level community control variables include the average household income, average dwelling value, the percentage of individuals with no high school degree, the percentage of individuals with a high school degree, the percentage of individuals with a university degree, the unemployment rate, the percentage of immigrants, the percentage of visible minorities, and the percentage of the population over 65 years old.

### *B. Regression Sample*

Because a value-added model in test scores is estimated, the sample is restricted to students who wrote both the 4th- and 7th-grade mathematics and reading exams. Since test scores were observed between 1999 and 2006, and since three years pass between each test, most such students were observed between 2002 and 2006. There were 229,337 students observed writing the grade 7 test between 2002 and 2006. Of these students, 24,026 (10.5 percent) who were not observed in

[10] This process is described in detail in a data appendix that is available from the author upon request.

grade 4 were dropped from the sample, and a further 14,692 students (6.5 percent) who did not have a valid test score in both years were also dropped. Additionally, 3260 students (1.4 percent) who had abnormal data or grade progression were dropped[11], 657 students (<1 percent) who were missing school information in grades 5 or 6 were dropped, as were 1532 students (<1 percent) who attended schools with irregular grade level configurations.[12] The final analysis sample consists of 185,170 student observations.

For the longer run sample, the 7th grade students who were tested between 2002 and 2006 were followed until 2010 or until high school graduation. Each longer run outcome variable has a unique sample size discussed below and uses a different sample than the FSA value added regressions. The first longer run outcome is the 10th grade mandatory provincial English exam. This exam is worth 20 percent of a student's final mark in their 10th grade English class and is mandatory for all 10th grade students with the exception of students with special needs. Of the 185,170 student observations in the main analysis sample, 12,043 (6.5%) students are not included in the Ministry of Education data attending grade 10. This discrepancy could be due to students moving out of province, due to students moving to a private school or due to administrative errors in record keeping. An additional 10,392 (5.6%) students do not have a 10th grade English exam. These are students that are not required to take the exam due to exemptions related to factors such as having an individual education plan for special needs.[13] Therefore, the final analysis sample for this outcome variable is 162,735 observations.

The second longer run outcome, the 12th grade mandatory provincial English exam score, is worth 40 percent of a student's final mark in 12th grade English class. Of the 113,714 student

[11] For instance, students that were retained more than once, skipped a grade level, or moved down a grade level.
[12] Irregular grade level configurations generally occur in special types of schools such as online distance education schools or schools with other special characteristics.
[13] The 4th grade test scores of the students missing from the sample are significantly lower than the students in the sample. However, they are not statistically significantly different based on whether or not they attended middle school.

observations in the main analysis sample who were in 7th grade between 2002-2004, 16,543 (15.5%) students are not included in the Ministry of Education data. This discrepancy is due to issues similar to the 10th grade exam along with students who dropped out of high school. An additional 15,690 (13.8%) students do not have a grade 12 English exam score. Therefore, the final analysis sample for this outcome variable is 81,481 observations.

The final two longer run outcomes, high school graduation and high school grade point average, use the 7th grade cohorts from 2002 and 2003. This sample restriction allows students five years to graduate from high school. Of the 75,942 student observations in the main analysis sample, I use the sample of 71,479 students that attended 9th grade between 2003 and 2008. In this sample, I may miscode students that have left the province or have moved to a private school during high school as dropping out of high school. Finally, I only have information on high school grade point average for students who have graduated from high school. Therefore, conditional on graduating high school, I have 58,292 observations. This sample is reduced to 58,232 due to 60 students with missing information for this variable.

### *C. Descriptive Statistics*

Table 1 displays descriptive statistics for the data by grade level configuration of the student's 4th grade school. Column 1 includes only students who were attending a school ending in 5th grade, column 2 includes only students who were attending a school ending in 6th grade, and column 3 includes students who were attending a school ending in 7th grade or higher.[14] A bold number in columns 1 or 2 indicates that that mean of the variable is statistically significantly different than the mean level of that variable in column 3.

[14] Only 2.5% of students attended a school ending in a grade higher than 7th grade. All results of the paper are similar if this sample of students are excluded.

Panel A includes the descriptive statistics for the student-level variables. As can be seen by comparing columns, the difference in mean characteristics across the groups can be relatively small in some variables yet are still statistically significantly different. In addition, there are also some large differences between the samples. In terms of notable differences in student characteristics, there are fewer aboriginal students in schools that end in grade 5 and more ESL students in schools that end in grade 7 or higher. Panel B displays the community characteristics gathered from the census for each type of grade level configuration. Some striking differences include the finding that students who attended a school that ended in grade 6 had lower household income, lower average dwelling values, and higher high school dropout rates than students from the other two grade level configurations. The other notable difference between the community characteristics of the different grade level configurations is with respect to percent immigrant and percent visible minority. Schools that ended in grade 6 had much lower percentages of both.

Panel C and D include the mean levels of 4th and 7th grade test scores. The means of test scores are slightly positive in all columns, which indicates that the students who were excluded from the samples scored marginally worse than the students who were included in the sample.[15] There are also statistically significant differences in 4th-grade math and reading test scores. The students who attended a school that ended in 5th grade scored higher math and reading scores than the other students in different grade level configurations. However, a different pattern emerges for the 7th grade test scores. Students in schools that ended in grade 7 or later did better in both math and reading. The students in schools that ended in grade 6—the same students who were doing better than the rest in grade 4—scored lower compared to the students in column 3. This provides some indication that the analysis will find negative effects associated with attending middle or junior high school. Finally, in Panel E, the summary statistics, along with the corresponding sample sizes, are listed for the longer run outcomes.

[15] These scores are standardized to have a mean of zero and standard deviation of one in the population.

Overall Table 1 illustrates that the grade configuration of the school a student attends in grade 4 is not exogenous. However, using the grade 4 test score as a control in the model eliminates differences in achievement levels across students in grade 4. But the type of school attended in grade 4 could be correlated with unobserved student characteristics that affect learning trajectories after grade 4. Unfortunately, in this data, there is no information on other tests in different grades to estimate if the trajectory between students in different grade configurations before middle or junior high school attendance is different. However, in the New York City data, Rockoff and Lockwood (2010) find no difference in trajectories before middle school attendance. This provides some evidence that the learning trajectories of students in varying grade configurations in British Columbia may also be similar.

Table 2 includes summary statistics regarding the schools in the sample. There are approximately 200 schools in each of the 5th and 6th grade samples and approximately 1000 schools in the 7th grade sample. There are fewer statistically significant differences between these samples in terms of school characteristics. However, the 7th grade sample has some notable differences. Most evident is that these schools tend to be bigger. They have higher enrollments along with more teachers, classrooms, support staff, and administrators. They also tend to be in more rural areas.

This data allows students to be followed along their individual academic paths. The earliest students are observed in the data is in 4th grade. The grade span of the school the student is attending in grade 4 is used to split the students into three samples and each of these samples of students is split into two groups, the first group includes students that are “on path” and the second group includes students that are “off path”. An example of student who is “on path” is a student in the grade 5 sample, which means that this student is in a school in grade 4 that ends after grade 5. In grade 6, this student is observed entering a middle school. That same student would be “off path” if in grade 6, they moved to a school that was not a middle school. Table 3 includes descriptive statistics for these different samples of students. Overall, approximately 12 percent students are “off path”.

However, this percentage varies by the ending grade of the grade 4 school. For instance, about 12 percent of students are “off path” in the grade 5 and grade 7 samples, whereas 21 percent are “off path” in the grade 6 sample. The differences in characteristics between students “on path” and “off path” are tested for statistical significance. Overall, students that are “off path” tend to score worse in math and reading in both 4th and 7th grade. They are more likely to be male, aboriginal and in special education. The community characteristic patterns are less pronounced. The “off path” students in the grade 5 sample come from communities with lower average household income and average dwelling values whereas these students in the grade 6 sample come from communities that have higher household incomes and dwelling values. However, what is clear is that the estimates from the instrumental variables estimation strategy apply to students that are different than the students who are “off path”.

Finally, Table 4 explores the summary statistics of the three estimation samples used in this research. The first column includes the full sample. The second column includes only districts in which 15 percent or more of its students attended a middle or junior high school.[16] The third column includes only cities in which 15 percent or more of the students attended a middle or junior high school.[17] The second and third sample is used to limit the identification to students who had the opportunity to attend a middle or junior high school. Panel A provides background on the distribution of the different types of grade level configurations. As previously noted, about 32 percent of students attend a middle or junior high school in British Columbia. If the sample is restricted to districts and cities that have more than 15 percent of their students attending a middle or junior high school, this

[16] These districts are Southeast Kootenay, Rocky Mountain, Kootenay Lake, Kootenay-Columbia, Central Okanagan, Abbotsford, New Westminster, Powell River, Okanagan Similkameen, Bulkley Valley, Prince George, Nicola-Similkameen, Peace River South, Greater Victoria, Sooke, Gulf Islands, Alberni, Fraser-Cascade, and Cowichan Valley.

[17] These cities are Abbotsford, Armstrong, Castlegar, Cranbrook, Fruitvale, Hope, Lake Cowichan, Lumby, New Westminster, Pemberton, Powell River, Prince George, Princeton, Salmon Arm, Smithers, Trail, Victoria, and Whistler.

number increases to 63 and 58 percent, respectively. In addition, column 2 shows that there are more students attending junior high school in this sample than in the sample including only cities. Panels B and C examine the 4th and 7th grade test scores of each of these three samples. The 4th-grade test scores between the three samples are similar in magnitude but statistically different from each other. The similarity in magnitude is reassuring as it implies that districts and cities that have a large number of middle and junior high schools are not radically different in terms of their ability to produce grade 4 test scores. Therefore, the analysis can assume that the students are starting at a relatively similar level in grade 4 in all three samples. However, a large significant difference can be seen in the 7th grade test scores between the three samples. This once again gives some indication that students who attend a middle or junior high school score worse in 7th grade than their counterparts that do not attend a middle or junior high school. Finally, in Panel D, the longer run outcomes are examined. All that outcomes are statistically significantly different in the two restricted samples compared to the full sample. Figure 1 provides a visual representation of the districts and cities that contain more than 15 percent of students who attend a middle or junior high school.

## V. Results

### *A. Main Effects*

The analysis begins by estimating equation (1) using the short run data described in Section IV. Table 5 contains these results. Panel A includes the results from the ordinary least squares specification. All specifications include standard errors that are clustered at the district level. Column 1 lists the estimates from a specification that includes no control variables and was run using the full sample of students in British Columbia. The point estimates indicate that students who attended a middle or junior high school in 6th or 7th grade scored 0.158 standard deviations lower than students who did not. The student, school, and census control variables are added in column 2, and the point estimates decrease in magnitude to -0.125 standard deviations. Because grade level configurations are determined at the district level, it is appropriate to take into account differences between districts that choose different grade level configurations. Therefore, district fixed effects are added in column 3. Including district fixed effects does not substantially affect the estimated coefficient. Column 4 limits the sample to include only school districts that contained 15 percent of more of their students in a middle or junior high school in 7th grade.[18] This estimate is based on only students that were in districts that offered middle or junior high schools to at least 15 percent of the student body. The point estimate for this sample, which includes district fixed effects, is -0.141. Finally, a district may offer middle or junior high school but only in certain cities, and the identification in the previous column may be from differences across individuals from different cities. Therefore, the sample is again limited to include only cities in which more than 15 percent of the students attend a middle or junior high school. In this specification, city fixed effects are included so that the identification comes from students within cities, rather than across cities.[19] Using this sample, I find that attending a middle or junior high school decreases math scores by 0.187 standardized units. Columns 6 through 10 display the coefficients for the reading test. Overall, the point estimates are about half the size of the math estimates. Compared to the estimates of Rockoff and Lockwood (2010) which estimated one-year gains, the estimates in Panel A of Table 4, which are for three-year gains, are slightly lower in magnitude but overall consistent with their findings. Schwartz et al. (2011) used

[18] These specifications include only 19 districts, so having too few clusters may be a problem. Therefore, following Cameron and Miller (2010) and Cohen and Dupas (2010), the tables use critical values from a $t_{G-1}$ distribution where G is 19 (for each cluster). The critical values for 1%, 5%, and 10% significance are 2.878, 2.101, and 1.734, respectively. However, Hansen (2007) has shown that the standard errors listed in the tables, which were computed with the STATA cluster command, are reasonably good at correcting for serial correlations in panels with as low as 10 clusters.

[19] The estimates are similar if district fixed effects are included. Also, the magnitudes of the estimates are similar but are less precise if the samples include districts and cities with more than 25 percent of the students attending a middle or junior high school. This is probably due to the decrease in sample size.

a different specification, but also found estimates larger than the estimates from Panel A. Both these studies used test scores that were a combination of lower-stakes tests prior to No Child Left Behind and high-stakes tests after No Child Left Behind was enacted in 2002. Therefore, the difference in magnitude may be due to the difference in types of tests between the two jurisdictions.

The first stage of the two-stage least squares specification can be found in Panel B. As can be seen, the instrumental variable is strongly correlated with actual entry into middle or junior high school. The F-statistic ranges from 35 to 407. The coefficients in columns 1 and 2 are similar in magnitude to coefficients found in Rockoff and Lockwood (2010). The first-stage results found are consistent with the finding that some students are “off path”—i.e., they don’t follow the proscribed path set by the grade level configuration in 4th grade. The magnitude of the coefficient decreases when district or city fixed effects are included, but the instrument remains valid. The coefficient decreases because the average percentage of students being “on path” in some districts is very low. For instance, in District 85—Vancouver Island North—there are 10 schools in the district: six schools that are kindergarten through 7th grade, one school that is kindergarten through 5th grade, one school that is kindergarten through 10th grade, and two schools that are 8th through 12th grade schools. The individuals attending the kindergarten through 5th grade school in 4th grade cannot follow the “correct” path and attend a middle school as there are no middle schools in this district, so all of these students move to a kindergarten through 7th grade school or kindergarten through 10th grade school in grade 6. Therefore, the first-stage coefficient for this district is incredibly low. In addition, some schools change their grade level configurations during this period of time. The students in these schools will be “off-path” in the sense that their 4th grade school grade level configuration will not predict their school movements over time due to the change in grade level configurations. Hence, it is important to remember that the results from the two-stage least squares estimates are local average treatment effects. They apply only to students who follow the “correct” path of schools predicted by their grade 4 grade level configuration.

Panel C reports the estimates from the two-stage least squares estimates. Overall, the coefficients for math are slightly larger than the ordinary least squares estimates but continue to be statistically significant. The estimates are not statistically significant in the reading specifications when district or city fixed effects are included. Estimates from Rockoff and Lockwood (2010) found that math achievement falls by roughly 0.17 standard deviations and English achievement falls by 0.14–0.16 standard deviations when measured in 8th grade. The yearly magnitude estimated by Rockoff and Lockwood (2010) is approximately three times larger than the effects estimated in this paper. In addition, Rockoff and Lockwood (2010) found significant results for the English tests, whereas I find little to no statistically significant results for the reading test scores once district or city fixed effects are included. These differences may be due to the difference in types of tests between the two jurisdictions.

### *B. Middle or Junior High School?*

Next, I explore whether moving to a middle school in grade 6 has a different effect than moving to a junior high school in grade 7. Table 6 has the results for the specification that includes two dummy variables, one for moving to a middle school in grade 6 and one for moving to a junior high school in grade 7. The specification is run using ordinary least squares in Panel A and two-stage least squares in Panel B. The estimates for middle school and junior high school are roughly the same for both math and reading in Panel A. This implies that there might be a one-time shock to test scores, but that spending two years in a middle school before the exam in 7th grade is not necessarily worse than spending one year in a junior high school before taking the exam. In Panel B, there exist some non-significant results for the junior high school coefficients for both math and reading. Therefore, there is some evidence of a larger negative effect for attending middle school versus junior high school when tested in 7th grade. This is a slightly surprising result, as the disruption of moving to a junior high school would be fresher than if the student moved the year prior. However, Rockoff and Lockwood (2010) found a similar pattern using New York City data. In addition, Cook et al. (2008) came to a similar conclusion regarding discipline problems using North Carolina data, and hypothesized that younger students may be more sensitive to the negative influences of older students.

### *C. Heterogeneous Effects*

Table 7 explores whether different district characteristics such as being a rural or small district matters. The estimation strategy used in Panel A estimates equation (1) that includes augmenting that specification with an indicator variable for whether the district is one of the 30 smallest districts (out of 60 districts) in British Columbia in terms of enrollment along with this variable interacted with the middle/junior high school indicator variable. These 30 districts contain approximately 20 percent of the population of students. The estimation strategy used in Panel B is similar to the strategy used in Panel A but includes instead an indicator variable for whether the district is rural and its interaction with the middle/junior high school indicator. A district is considered rural if more than 50 percent of the students in that district live in a rural postal code. Roughly 10 percent of students attend a school in a district that is designated as rural. The first column in Table 7 corresponds to the third column in Tables 5 and 6. It includes the entire sample along with district fixed effects. Column 2 corresponds to the sample of only districts with 15 percent or greater of students attending a middle or junior high school along with district fixed effects. Column 3 includes cities with 15 percent or greater of students attending a middle or junior high school along with city fixed effects. These three columns are repeated for the reading test and for the math and reading test results using two-stage least squares. Overall, the interaction effect for both the small districts and rural districts are not statistically significantly different than the main middle/junior high school effect.

Table 8 explores whether the negative effect of attending middle and junior high school varies across demographic characteristics. Panel A examines gender by interacting an indicator variable for male with the middle/junior high school indicator variable. Each test and estimation strategy includes results for the three different samples/specifications outlined in the discussion regarding Table 7. Overall, there is very little evidence that males are affected differently than females. The same is true for students in special education (Panel B), aboriginal students (Panel C), and ESL students (Panel D). However, Panel E includes an indicator for whether the student scored in the lowest 50 percent of test takers in 4th grade. This indicator is interacted with the middle/junior high school variable. Here we see a very large negative effect for those on the lower half of the ability distribution. In particular, in reading, the whole effect is driven by these lower achieving students. These findings correspond to those of Rockoff and Lockwood (2010) but have some dissimilarities with those of Schwartz et al. (2011) as they found no differential impacts for females, special education students, or limited English proficiency-eligible students in math. They did, however, find large positive effects for limited English proficiency-eligible students in reading. I find no heterogeneous effects in reading for ESL students. These differences may be due to differences in the programs available to the ESL students in these two locations.

### *D. Attrition and Sample Selection*

As mentioned in Section III, this sample does not include students who have moved out of province or moved to private schools. There are also a variety of sample restrictions that needed to be made that are outlined in detail in Section IV. In this data, students who are excluded from the sample are more likely to be male, aboriginal, in special education, and English as a second language speakers. Therefore, the loss of these students from the sample may bias the estimates for the population of students if the test scores of the students who are excluded from the sample is correlated with the intended path of grades. While correcting for this bias is difficult with this type of estimation strategy and data structure, I nevertheless conduct two types of analysis to explore the potential for bias.

First, following Schwartz et al. (2011), I calculate an inverse Mills ratio and include this ratio in equation (1). Notwithstanding the fact that my current data may not fully explain the reasons for attrition from my sample, I use the available data to estimate a probit model which predicts the probability that a student will attrit. I use this predicted probability to try to address the possible omitted variable bias caused by non-random attrition. I do not have a variable that causes students to leave the sample and can be excluded from the main specifications, so identification relies on functional form. In Table 9, I redo the analysis from Panel A in Table 5 by including the inverse Mills ratio, denoted lambda, in the estimating equation. Overall, the main effects of middle/junior high school attendance are very similar to the estimates in Table 5. Interestingly, lambda is statistically significant at the 5 percent level in columns 1-3 and columns 6-8 but not in the restricted sample analysis found in columns 4-5 and columns 9-10.

Second, I explore the implications of different plausible assumptions about missing data. In the spirit of Horowiz and Manski (2000) and Lee (2002), I create bounds of my estimates.[20] First, I estimate the lower- and upper bound-estimates. This is accomplished by assuming the "worst case scenario" for the data. The lower (upper) bound is calculated by imputing the minimum (maximum) value of test scores for students that attended middle school, and by imputing the maximum (minimum) value of the test scores for students that did not attend middle school. These bounds are labeled "Lower" and "Upper". Next, I impute the lower (upper) bound by calculating the mean minus (plus) 0.10 standard deviations. I finally impute the lower (upper) bound by calculating the mean minus (plus) 0.25 standard deviations. As can be seen from the estimates in Panel B, the effect of middle/junior high school may vary from no effect to a -0.272 standard deviations in math and -0.188 standard deviations in reading. However, other than the lower bound for reading, all the estimates are negative which gives some indication that despite potential sample selection bias, middle/junior high school attendance causes a negative effect in terms of math and reading test score gains.

### *E. Longer Run Outcomes*

The results for the 4th to 7th grade math and reading test score gains indicate that attending a middle or junior high school has negative effects on academic achievement. However, it could be the case that these negative effects are temporary and that students who attend middle or junior high school "catch" up academically. Therefore, it is important to examine longer run outcomes.

Table 10 examines four longer run outcomes: (1) the mandatory 10th grade provincial English exam (2) the mandatory 12th grade provincial English exam (3) whether or not the

[20] Two key assumptions needed for this process are (1) "as good as" random assignment of treatment and (2) a monotonicity condition. In this analysis, I do not meet these assumptions but include the estimates of the bounds to provide the readers some information on the possible bounds of the estimate due to non-random sample selection.

student graduated from high school (4) the GPA of the student conditional on graduating from high school. Columns 1-3 report the ordinary least square (Panel A) and instrumental variables (Panel B) estimates for the 10th grade English exam. Column 1 includes district fixed effects and finds a negative effect of middle or junior high school attendance. Column 2 restricts the sample to districts with more than 15 percent of students attending a middle or junior high school and Column 3 restricts the sample to cities with more than 15 percent of students attending a middle or junior high school. The instrumental variables estimates find that attending a middle or junior high school decreases 10th grade English exam scores by 0.088-0.118 standard deviations. Columns 4-6 repeat this exercise with the 12th grade English exam scores and finds a larger negative but more imprecise effect that ranges from 0.164-0.221 standard deviations for the instrumental variables analysis. These estimates show evidence that middle or junior high school attendance has long run impacts on academic outcomes. Columns 7-9 explore whether, conditional on being in observed in 9th grade, attending a middle or junior high school makes a student more or less likely to graduate from high school within five years. Using the instrumental variables estimates, there is little evidence that there exists any relationship. Finally, Columns 10-12 examine whether, conditional on graduating from high school, attending a middle or junior high school affects that student's overall high school grade point average. There is no evidence of a relationship in columns 10 and 11 but a negative relationship arises after restricting the sample to only cities with more than 15 percent of student attending a middle or junior high school. This provides some evidence that the grade configuration may affect a student's GPA conditional of the student graduating from high school.[21]

[21] Appendix Table 1 repeats the exercise conducted in Table 9 to examine the effect of attrition on these longer run samples. Overall, the upper and lower bounds become much larger than in Table 9 but the other bounds and results including the Inverse Mills Ratio show roughly consistent estimates compared to Table 10.

The estimates in Table 10 all come from estimation strategies that include the 4th grade FSA exam score as a control variable. An interesting exercise is to also include the 7th grade FSA exam as a control variable as this may be able to shed light on the academic achievement trajectories of these students. Clearly, this may be a problematic strategy as the 7th grade FSA scores may be endogenous, but the outcome to this exercise can provide some intuition. Therefore, in Appendix Table 2, Table 10 is re-estimated with the addition of the grade 7 exam scores as a control variable. When 7th grade exam scores are included as control variables the negative relationship found in Table 10 for the 10th and 12th grade English exams is no longer statistically significant. This supports the possibility that the negative relationship between attending middle and junior high school is a localized effect that hurts students in the initial years after moving schools but that the student trajectories follow a similar path as non-middle/junior high school attenders in high school. Due to lack of data, this is as far as this exercise can go but these findings suggest that further investigation is warranted regarding achievement trajectories.

***F. Moving or Middle/Junior High School?***

A possible interpretation of these findings is that the effects found have only to do with the act of moving schools and nothing to do with attending a particular type of grade level configuration. The literature generally finds negative effects of moving schools on the student's academic achievement (see Engec 2006; Gruman et al. 2008; Ingersoll et al. 1989; Mehana and Reynolds 2004). However, it is difficult to separate whether this negative effect is due to the act of moving or due to the characteristics and circumstances of the students who move. Therefore, is it difficult to disentangle whether the results found above are due to simply moving schools versus moving to a middle or junior high school.

Ideally, one could find an exogenous reason for students to move schools and then compare the effects of moving schools for those students with the effect of moving to a middle or junior high school. Unfortunately, finding an exogenous reason is difficult in these particular data. However, in Table 11, I explore the test score effects of moving for two different samples of movers. In Panel A, an indicator variable is used that equals one for all students who moved schools during this sample whose move was not related to attending a middle or junior high school. The point estimates indicate a negative relationship between changing schools and test score gains from grade 4 to grade 7. The magnitude is between one-third and one-half as large as the negative effects found for middle/junior high school attendance. However, this sample of students may be negatively academically selected to start with (Pribesh and Downey 1999). It may be that these students are likely to do worse than other students in terms of academic gains due to other unobservable characteristics. However, it is interesting that the correlation is much smaller than the point estimates found for middle/junior high school attendance.

Starting in 2000, many schools were closed in British Columbia due to decreasing student enrolments. In this sample, 56 schools closed between 2000 and 2005. In Panel B, I use the students that were forced to move schools due to school closure to estimate the effect of mobility on test score gains. The school closures were not exogenous events, as the schools were selected to be closed due to decreasing enrolments, and this may have been correlated with other unobserved factors. However, this is still informative as it may remove some of the selection into the movers' sample found in Panel A. Interestingly, moving schools due to school closures did not have any statistically significant effect on students' test score gains in math or reading.

Neither Panel A nor Panel B shows conclusive evidence of whether the effects found in this research are due to moving schools versus moving to a middle or junior high school.

However, they do show suggestive evidence that the move to middle or junior high school may be significantly worse on student achievement gains than just changing schools during the elementary years.

## VI. Conclusion

Overall, I find large, statistically significant negative effects of attending a middle or junior high school. The magnitudes are similar to other education interventions such as improving a teacher by one standard deviation (Aaronson, Barrow, and Sander 2007) or reducing class sizes (Harris 2009). The large effect size and the potential easy policy reform make changing grade level configurations an important and viable education reform. The adoption of a kindergarten through 8th grade configuration is becoming more popular with a variety of U.S. school districts that are moving in that direction, such as New York City, Cleveland, Cincinnati, Philadelphia, and Boston (Schwartz et al. 2011). This research shows that this reorganization may be quite beneficial and that British Columbia school districts may want to rethink their grade level configuration options.

Despite the consistent and large effects found in this research, it is still unclear exactly what is causing the negative effect of middle and junior high school attendance. Is it the grade distribution of the students in the school? Are middle/junior high schools less efficient? Do the peer effects matter? These are all questions that cannot be answered with these data but that are important for future research.

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Table 1
Descriptive statistics

| | Ending grade of school, Grade 4 | | |
|---|---|---|---|
| | Grade 5 | Grade 6 | Grade 7 or later |
| | (1) | (2) | (3) |
| *Panel A: Student characteristics* | | | |
| Male | 0.509 | 0.498 | 0.504 |
| | (0.500) | (0.500) | (0.500) |
| Aboriginal | **0.079** | **0.139** | 0.103 |
| | (0.270) | (0.346) | (0.304) |
| ESL | **0.168** | **0.060** | 0.245 |
| | (0.374) | (0.237) | (0.430) |
| In special education | **0.065** | 0.061 | 0.058 |
| | (0.247) | (0.240) | (0.234) |
| Number of observations | 24,257 | 25,241 | 135,672 |
| *Panel B: Community characteristics* | | | |
| Average household income | **56553** | **49547** | 57242 |
| | (18072) | (15984) | (22725) |
| Average dwelling value | **232170** | **185686** | 248776 |
| | (97016) | (99618) | (133107) |
| % no high school degree | **0.228** | **0.271** | 0.258 |
| | (0.095) | (0.096) | (0.108) |
| % high school degree | **0.268** | **0.266** | 0.265 |
| | (0.061) | (0.063) | (0.057) |
| % university degree | 0.196 | **0.144** | 0.197 |
| | (0.102) | (0.076) | (0.116) |
| % unemployed | **0.063** | **0.078** | 0.072 |
| | (0.047) | (0.060) | (0.057) |
| % immigrant | **0.239** | **0.131** | 0.263 |
| | (0.134) | (0.059) | (0.174) |
| % visible minority | **0.169** | **0.044** | 0.231 |
| | (0.181) | (0.053) | (0.249) |
| % of population over 65 yrs old | **0.132** | **0.138** | 0.120 |
| | (0.102) | (0.098) | (0.088) |
| Number of observations | 24,257 | 25,241 | 135,672 |
| *Panel C: 4th grade test scores* | | | |
| Math | **0.183** | **0.031** | 0.053 |
| | (0.905) | (0.896) | (0.931) |
| Reading | **0.146** | 0.071 | 0.063 |
| | (0.861) | (0.876) | (0.904) |
| Number of observations | 24,257 | 25,241 | 135,672 |
| *Panel D: 7th grade test scores* | | | |
| Math | **-0.017** | **-0.132** | 0.047 |
| | (0.907) | (0.880) | (0.951) |
| Reading | 0.073 | **-0.003** | 0.071 |
| | (0.884) | (0.904) | (0.913) |
| Number of observations | 24,257 | 25,241 | 135,672 |
| *Panel E: Longer run outcomes* | | | |
| English 10th grade exam | **0.110** | **0.007** | 0.070 |
| | (0.934) | (0.969) | (0.952) |
| Number of observations | 21,639 | 21,667 | 119,429 |
| English 12th grade exam | ***0.030*** | **-0.088** | 0.049 |
| | (0.959) | (0.939) | (0.980) |
| Number of observations | 9,978 | 10,311 | 61,192 |
| High school graduation | **0.838** | **0.796** | 0.816 |
| | (0.369) | (0.403) | (0.388) |
| Number of observations | 7,965 | 9,555 | 53,959 |
| High school GPA | **2.850** | **2.841** | 2.870 |
| | (0.590) | (0.572) | (0.581) |
| Number of observations | 6,655 | 7,582 | 43,995 |

Notes: Standard deviations in parentheses. Test scores represent the z-score by year, grade, and skill among the population of schools prior to sample exclusions. A bold number indicates the significance at the 5 percent level from a *t* test that compares the mean value in column 3 with the mean value in column 1 or column 2, respectively.

Table 2
Descriptive statistics of school characteristics

| | Ending grade of school, Grade 4 | | |
|---|---|---|---|
| | Grade 5 | Grade 6 | Grade 7 or later |
| | (1) | (2) | (3) |
| Percent excused from math test | **0.032** | **0.032** | 0.043 |
| | (0.036) | (0.037) | (0.050) |
| Percent excused from reading test | **0.032** | **0.033** | 0.043 |
| | (0.037) | (0.037) | (0.051) |
| Percent in special education | 0.083 | 0.090 | 0.089 |
| | (0.057) | (0.084) | (0.087) |
| Percent male | 0.512 | 0.513 | 0.514 |
| | (0.095) | (0.076) | (0.071) |
| Percent aboriginal | **0.121** | 0.165 | 0.160 |
| | (0.134) | (0.150) | (0.191) |
| Percent ESL | **0.179** | **0.104** | 0.216 |
| | (0.205) | (0.168) | (0.251) |
| Rural | **0.167** | 0.210 | 0.260 |
| | (0.373) | (0.407) | (0.437) |
| Pupil/teacher ratio | 14.421 | 15.168 | 15.180 |
| | (2.589) | (3.262) | (5.935) |
| Enrollment | **231.045** | **236.538** | 275.320 |
| | (117.213) | (125.808) | (159.394) |
| Number of teachers | **15.483** | **14.778** | 17.743 |
| | (7.104) | (6.822) | (9.499) |
| Number of classrooms | **9.933** | **9.931** | 11.306 |
| | (4.785) | (4.914) | (6.189) |
| Number of support staff | **2.196** | **1.944** | 2.822 |
| | (1.483) | (1.273) | (2.278) |
| Number of administrators | **0.774** | **0.772** | 0.861 |
| | (0.415) | (0.347) | (0.390) |
| Number of schools | 189 | 211 | 1,068 |

Standard deviations in parentheses. A bold number indicates the significance at the 5 percent level from a *t* test that compares the mean value in column 3 with the mean value in column 1 or column 2, respectively.

Table 3
Descriptive statistics of students by whether the student is on or off path

| | Ending grade of school, Grade 4 | | | | | |
|---|---|---|---|---|---|---|
| | Grade 5 | | Grade 6 | | Grade 7 or later | |
| | On path | Off path | On path | Off path | On path | Off path |
| | (1) | (2) | (3) | (4) | (5) | (6) |
| *Panel A: Student characteristics* | | | | | | |
| Male | 0.508 | 0.515 | 0.494 | **0.513** | 0.504 | 0.504 |
| | (0.500) | (0.500) | (0.500) | (0.500) | (0.500) | (0.500) |
| Aboriginal | 0.071 | **0.137** | 0.135 | **0.153** | 0.101 | **0.120** |
| | (0.258) | (0.344) | (0.342) | (0.360) | (0.301) | (0.325) |
| ESL | 0.170 | 0.158 | 0.049 | **0.098** | 0.257 | **0.138** |
| | (0.375) | (0.365) | (0.217) | (0.297) | (0.437) | (0.345) |
| In special education | 0.065 | 0.070 | 0.059 | **0.071** | 0.058 | 0.061 |
| | (0.246) | (0.255) | (0.235) | (0.258) | (0.234) | (0.239) |
| *Panel B: Community characteristics* | | | | | | |
| Average household income | 57245 | **51468** | 49431 | **50089** | 57867 | **52038** |
| | (18066) | (17297) | (15853) | (16462) | (23319) | (16070) |
| Average dwelling value | 235757 | **205800** | 180683 | **204669** | 253461 | **209783** |
| | (97336) | (90379) | (86555) | (136743) | (136440) | (92400) |
| % no high school degree | 0.222 | **0.269** | 0.271 | 0.271 | 0.258 | **0.256** |
| | (0.093) | (0.098) | (0.095) | (0.098) | (0.110) | (0.096) |
| % high school degree | 0.269 | **0.259** | 0.266 | 0.266 | 0.264 | **0.266** |
| | (0.060) | (0.065) | (0.061) | (0.070) | (0.058) | (0.054) |
| % university degree | 0.201 | **0.160** | 0.143 | **0.146** | 0.198 | **0.183** |
| | (0.102) | (0.096) | (0.074) | (0.081) | (0.118) | (0.096) |
| % unemployed | 0.062 | **0.072** | 0.077 | **0.082** | 0.072 | **0.071** |
| | (0.047) | (0.049) | (0.060) | (0.060) | (0.058) | (0.051) |
| % immigrant | 0.243 | **0.210** | 0.127 | **0.143** | 0.271 | **0.196** |
| | (0.132) | (0.143) | (0.052) | (0.076) | (0.178) | (0.124) |
| % visible minority | 0.173 | **0.145** | 0.040 | **0.060** | 0.242 | **0.138** |
| | (0.178) | (0.198) | (0.039) | (0.087) | (0.254) | (0.173) |
| % of population over 65 yrs old | 0.130 | **0.146** | 0.140 | **0.127** | 0.119 | **0.132** |
| | (0.100) | (0.112) | (0.100) | (0.087) | (0.088) | (0.091) |
| *Panel C: 4th grade test scores* | | | | | | |
| Math | 0.198 | **0.070** | 0.044 | **-0.019** | 0.057 | **0.018** |
| | (0.898) | (0.951) | (0.883) | (0.941) | (0.931) | (0.932) |
| Reading | 0.165 | **0.006** | 0.083 | **0.024** | 0.067 | **0.034** |
| | (0.848) | (0.946) | (0.859) | (0.938) | (0.901) | (0.933) |
| *Panel D: 7th grade test scores* | | | | | | |
| Math | -0.004 | **-0.106** | -0.132 | -0.132 | 0.066 | **-0.108** |
| | (0.894) | (0.995) | (0.858) | (0.957) | (0.952) | (0.925) |
| Reading | 0.094 | **-0.082** | 0.009 | **-0.047** | 0.080 | **-0.008** |
| | (0.864) | (1.003) | (0.877) | (0.997) | (0.908) | (0.948) |
| Number of observations | 21,353 | 2,904 | 19,976 | 5,265 | 121,121 | 14,551 |

Notes: Standard deviations in parentheses. Test scores represent the z-score by year, grade, and skill among the population of schools prior to sample exclusions. A bold number indicates the significance at the 5 percent level from a *t* test that compares the mean value in column 2 (4, 6) with the mean value in column 1 (3, 5).

Table 4
Descriptive statistics of outcome measures and grade configurations for estimation samples

| | All districts/cities in British Columbia | Only districts with > 15% of students in middle schools | Only cities with > 15% of students in middle schools |
|---|---|---|---|
| *Panel A: Grade configurations* | | | |
| Middle/junior high school | 0.317 | **0.630** | **0.582** |
| | (0.465) | (0.483) | (0.493) |
| Middle school in 6th grade | 0.162 | **0.255** | **0.356** |
| | (0.369) | (0.436) | (0.479) |
| Junior high school in 7th grade | 0.157 | **0.382** | **0.232** |
| | (0.364) | (0.486) | (0.422) |
| Number of observations | 185,170 | 47,264 | 29,935 |
| *Panel B: 4th grade test scores* | | | |
| Math | 0.067 | **0.034** | 0.066 |
| | (0.924) | (0.908) | (0.914) |
| Reading | 0.075 | 0.069 | **0.090** |
| | (0.896) | (0.891) | (0.887) |
| Number of observations | 185,170 | 47,264 | 29,935 |
| *Panel C: 7th grade test scores* | | | |
| Math | 0.014 | **-0.078** | **-0.038** |
| | (0.938) | (0.916) | (0.930) |
| Reading | 0.061 | **0.021** | **0.042** |
| | (0.908) | (0.919) | (0.924) |
| Number of observations | 185,170 | 47,264 | 29,935 |
| *Panel D: Longer run outcomes* | | | |
| English 10th grade exam | 0.067 | **0.013** | **0.038** |
| | (0.952) | (0.964) | (0.954) |
| Number of observations | 162,735 | 40,414 | 26,001 |
| English 12th grade exam | 0.029 | **-0.037** | **0.002** |
| | (0.973) | (0.970) | (0.983) |
| Number of observations | 81,481 | 19,647 | 12,620 |
| High school graduation | 0.816 | **0.794** | **0.790** |
| | (0.388) | (0.405) | (0.407) |
| Number of observations | 71,479 | 18,317 | 11,469 |
| High school GPA | 2.864 | **2.840** | **2.849** |
| | (0.581) | (0.574) | (0.585) |
| Number of observations | 58,232 | 14,516 | 9,065 |

Notes: Standard deviations in parentheses. Test scores represent the z-score by year, grade, and skill among the population of schools prior to sample exclusions. A bold number indicates the significance at the 5 percent level from a *t* test that compares the mean value in column 1 with the mean value in column 2 or column 3, respectively.

Table 5

Estimates of the effect of middle/junior high school on academic gains from 4th to 7th grade

| | Math | | | | | Reading | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) |
| Panel A: OLS | | | | | | | | | | |
| Middle/junior high school | **-0.158** | **-0.125** | **-0.130** | **-0.141** | **-0.187** | **-0.056** | **-0.065** | ***-0.055*** | **-0.079** | **-0.108** |
| | (0.033) | (0.027) | (0.030) | (0.031) | (0.029) | (0.018) | (0.016) | (0.028) | (0.023) | (0.026) |
| Panel B: First stage | | | | | | | | | | |
| Grade 4 | **0.776** | **0.697** | **0.294** | **0.359** | **0.341** | **0.781** | **0.697** | **0.294** | **0.359** | **0.341** |
| | (0.003) | (0.004) | (0.005) | (0.011) | (0.013) | (0.003) | (0.004) | (0.005) | (0.011) | (0.013) |
| Panel C: 2SLS | | | | | | | | | | |
| Middle/junior high school | **-0.192** | **-0.147** | **-0.138** | ***-0.116*** | **-0.215** | **-0.077** | **-0.082** | -0.062 | -0.051 | -0.085 |
| | (0.036) | (0.029) | (0.049) | (0.059) | (0.057) | (0.022) | (0.019) | (0.039) | (0.049) | (0.062) |
| Number of observations | 185170 | 185170 | 185170 | 47264 | 29935 | 185170 | 185170 | 185170 | 47264 | 29935 |
| Control variables: | | | | | | | | | | |
| Student/school/census | no | yes | yes | yes | yes | no | yes | yes | yes | yes |
| District fixed effects | no | no | yes | yes | no | no | no | yes | yes | no |
| City fixed effects | no | no | no | no | yes | no | no | no | no | yes |
| Sample: | | | | | | | | | | |
| Full sample | yes | yes | yes | no | no | yes | yes | yes | no | no |
| Only districts > 15% | no | no | no | yes | no | no | no | no | yes | no |
| Only cities > 15% | no | no | no | no | yes | no | no | no | no | yes |

Standard errors corrected for clustering at the district level are in parentheses. Critical values for columns 4, 5, 9 & 10 are from a *t*-distribution with 18 degrees of freedom. Bold coefficients are statistically significant at the 5% level. Bold italic coefficients are statistically significant at the 10% level. See Section IV for a description of the demographic and census variables included in the regressions. The F-statistics for the first stage regressions range from 35 to 407.

Table 6

Estimates of the effect of middle or junior high school on academic gains from 4th to 7th grade

| | Math | | | | | Reading | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) |
| Panel A: OLS | | | | | | | | | | |
| Middle school grade 6 | **-0.130** | **-0.125** | **-0.146** | **-0.148** | **-0.179** | -0.028 | **-0.053** | **-0.057** | **-0.078** | **-0.090** |
| | (0.034) | (0.035) | (0.029) | (0.033) | (0.027) | (0.017) | (0.020) | (0.026) | (0.026) | (0.032) |
| Junior high school grade 7 | **-0.185** | **-0.123** | **-0.113** | **-0.123** | **-0.185** | **-0.086** | **-0.079** | -0.055 | **-0.073** | **-0.128** |
| | (0.033) | (0.027) | (0.039) | (0.040) | (0.042) | (0.022) | (0.021) | (0.036) | (0.031) | (0.027) |
| Panel B: 2SLS | | | | | | | | | | |
| Middle school grade 6 | **-0.166** | **-0.162** | **-0.178** | **-0.166** | **-0.208** | **-0.051** | **-0.079** | **-0.086** | ***-0.079*** | -0.064 |
| | (0.036) | (0.032) | (0.050) | (0.063) | (0.057) | (0.022) | (0.021) | (0.031) | (0.039) | (0.055) |
| Junior high school grade 7 | **-0.217** | **-0.125** | -0.038 | -0.023 | **-0.178** | **-0.101** | **-0.080** | 0.009 | 0.006 | -0.106 |
| | (0.040) | (0.034) | (0.054) | (0.063) | (0.078) | (0.024) | (0.027) | (0.064) | (0.069) | (0.110) |
| Number of observations | 185170 | 185170 | 185170 | 47264 | 29935 | 185170 | 185170 | 185170 | 47264 | 29935 |
| Control variables: | | | | | | | | | | |
| Student/school/census | no | yes | yes | yes | yes | no | yes | yes | yes | yes |
| District fixed effects | no | no | yes | yes | no | no | no | yes | yes | no |
| City fixed effects | no | no | no | no | yes | no | no | no | no | yes |
| Sample: | | | | | | | | | | |
| Full sample | yes | yes | yes | no | no | yes | yes | yes | no | no |
| Only districts > 15% | no | no | no | yes | no | no | no | no | yes | no |
| Only cities > 15% | no | no | no | no | yes | no | no | no | no | yes |

Standard errors corrected for clustering at the district level are in parentheses. Critical values for columns 4, 5, 9 & 10 are from a *t*-distribution with 18 degrees of freedom. Bold coefficients are statistically significant at the 5% level. Bold italic coefficients are statistically significant at the 10% level. See Section IV for a description of the demographic and census variables included in the regressions. The F-statistics for the first stage regressions range from 15 to 293.

Table 7

Estimates of the effect of middle/junior high school on academic gains from 4th to 7th grade by district characteristics

| | OLS | | | | | | 2SLS | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Math | | | Reading | | | Math | | | Reading | | |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) | (12) |
| Panel A: Smallest 30 districts | | | | | | | | | | | | |
| Middle/junior high school | **-0.138** | **-0.169** | **-0.200** | -0.043 | **-0.101** | **-0.112** | **-0.190** | **-0.207** | **-0.316** | -0.080 | **-0.141** | ***-0.154*** |
| | (0.040) | (0.041) | (0.031) | (0.040) | (0.028) | (0.029) | (0.069) | (0.099) | (0.058) | (0.053) | (0.072) | (0.080) |
| Middle/junior school * small district | 0.005 | 0.046 | 0.037 | -0.047 | 0.027 | 0.011 | 0.116 | 0.156 | **0.290** | 0.025 | 0.143 | 0.195 |
| | (0.066) | (0.074) | (0.060) | (0.061) | (0.061) | (0.056) | (0.094) | (0.121) | (0.076) | (0.074) | (0.087) | (0.115) |
| Panel B: Rural districts | | | | | | | | | | | | |
| Middle/junior high school | **-0.133** | **-0.143** | **-0.197** | ***-0.055*** | **-0.078** | **-0.122** | **-0.142** | -0.094 | **-0.223** | -0.052 | -0.024 | -0.076 |
| | (0.032) | (0.030) | (0.028) | (0.031) | (0.024) | (0.026) | (0.052) | (0.071) | (0.055) | (0.044) | (0.066) | (0.064) |
| Middle/junior school * rural district | 0.014 | 0.014 | 0.090 | 0.001 | -0.001 | 0.123 | 0.015 | -0.075 | 0.179 | -0.037 | -0.095 | -0.216 |
| | (0.050) | (0.066) | (0.113) | (0.032) | (0.054) | (0.078) | (0.067) | (0.105) | (0.261) | (0.047) | (0.106) | (0.317) |
| Number of observations | 185170 | 47264 | 29935 | 185170 | 47264 | 29935 | 185170 | 47264 | 29935 | 185170 | 47264 | 29935 |
| Control variables: | | | | | | | | | | | | |
| Student/school/census variables | yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | yes |
| District fixed effects | yes | yes | no | yes | yes | no | yes | yes | no | yes | yes | no |
| City fixed effects | no | no | yes | no | no | yes | no | no | yes | no | no | yes |
| Sample: | | | | | | | | | | | | |
| Full sample | yes | no | no | yes | no | no | yes | no | no | yes | no | no |
| Only districts > 15% | no | yes | no | no | yes | no | no | yes | no | no | yes | no |
| Only cities > 15% | no | no | yes | no | no | yes | no | no | yes | no | no | yes |

Standard errors corrected for clustering at the district level are in parentheses. Critical values for all columns except columns 1, 4, 7, & 10 are from a *t*-distribution with 18 degrees of freedom. Bold coefficients are statistically significant at the 5% level. Bold italic coefficients are statistically significant at the 10% level. See Section IV for a description of the demographic and census variables included in the regressions.

Table 8

Estimates of the effect of middle/junior high school on academic gains from 4th to 7th grade by student demographic characteristics

| | OLS | | | | | | 2SLS | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Math | | | Reading | | | Math | | | Reading | | |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) | (12) |
| Panel A: Male | | | | | | | | | | | | |
| Middle/junior high school | **-0.130** | **-0.149** | **-0.198** | ***-0.050*** | **-0.083** | **-0.107** | **-0.143** | **-0.143** | **-0.266** | -0.058 | -0.062 | -0.098 |
| | (0.031) | (0.033) | (0.029) | (0.028) | (0.024) | (0.028) | (0.049) | (0.060) | (0.060) | (0.039) | (0.046) | (0.057) |
| Middle/junior school * male | -0.002 | 0.016 | 0.023 | -0.011 | 0.008 | -0.002 | 0.010 | ***0.055*** | 0.100 | -0.007 | 0.023 | 0.025 |
| | (0.009) | (0.014) | (0.016) | (0.010) | (0.012) | (0.013) | (0.012) | (0.027) | (0.058) | (0.013) | (0.029) | (0.057) |
| Panel B: Special education | | | | | | | | | | | | |
| Middle/junior high school | **-0.131** | **-0.143** | **-0.189** | **-0.055** | **-0.082** | **-0.113** | **-0.141** | ***-0.121*** | **-0.219** | -0.063 | -0.057 | -0.096 |
| | (0.030) | (0.031) | (0.029) | (0.028) | (0.024) | (0.027) | (0.049) | (0.060) | (0.059) | (0.039) | (0.048) | (0.061) |
| Middle/junior school * special education | 0.018 | 0.043 | 0.042 | -0.004 | 0.054 | 0.085 | 0.044 | 0.094 | 0.086 | 0.015 | 0.122 | **0.220** |
| | (0.020) | (0.028) | (0.028) | (0.023) | (0.045) | (0.050) | (0.027) | (0.070) | (0.094) | (0.030) | (0.080) | (0.096) |
| Panel C: Aborginal | | | | | | | | | | | | |
| Middle/junior high school | **-0.131** | **-0.141** | **-0.190** | ***-0.053*** | **-0.077** | **-0.115** | **-0.138** | ***-0.113*** | **-0.210** | -0.056 | -0.036 | -0.084 |
| | (0.030) | (0.032) | (0.030) | (0.028) | (0.023) | (0.025) | (0.049) | (0.061) | (0.061) | (0.038) | (0.047) | (0.066) |
| Middle/junior school * aboriginal | 0.004 | -0.001 | 0.028 | -0.015 | -0.011 | 0.061 | -0.005 | -0.023 | -0.041 | -0.046 | -0.113 | -0.013 |
| | (0.025) | (0.040) | (0.041) | (0.028) | (0.040) | (0.038) | (0.032) | (0.063) | (0.081) | (0.037) | (0.080) | (0.092) |
| Panel D: ESL | | | | | | | | | | | | |
| Middle/junior high school | **-0.131** | **-0.137** | **-0.188** | **-0.055** | **-0.072** | **-0.104** | **-0.139** | ***-0.096*** | **-0.187** | -0.062 | -0.036 | -0.060 |
| | (0.031) | (0.030) | (0.030) | (0.028) | (0.024) | (0.027) | (0.050) | (0.053) | (0.047) | (0.039) | (0.044) | (0.060) |
| Middle/junior school * ESL | 0.008 | -0.038 | 0.011 | 0.001 | -0.066 | -0.032 | 0.010 | -0.207 | -0.193 | 0.005 | -0.156 | -0.175 |
| | (0.068) | (0.058) | (0.067) | (0.059) | (0.041) | (0.045) | (0.076) | (0.123) | (0.156) | (0.065) | (0.134) | (0.166) |
| Panel E: Low 4th grade scores | | | | | | | | | | | | |
| Middle/junior high school | **-0.101** | **-0.091** | **-0.149** | 0.021 | 0.015 | -0.025 | ***-0.101*** | -0.046 | **-0.154** | 0.019 | 0.053 | 0.014 |
| | (0.031) | (0.033) | (0.030) | (0.028) | (0.025) | (0.028) | (0.053) | (0.066) | (0.067) | (0.038) | (0.047) | (0.066) |
| Middle/junior school * low score | **-0.057** | **-0.100** | **-0.076** | **-0.152** | **-0.190** | **-0.169** | **-0.078** | **-0.140** | **-0.127** | **-0.176** | **-0.224** | **-0.217** |
| | (0.013) | (0.015) | (0.016) | (0.012) | (0.017) | (0.022) | (0.017) | (0.027) | (0.043) | (0.014) | (0.027) | (0.045) |
| Number of observations | 185170 | 47264 | 29935 | 185170 | 47264 | 29935 | 185170 | 47264 | 29935 | 185170 | 47264 | 29935 |
| Control variables: | | | | | | | | | | | | |
| Student/school/census variables | yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | yes |
| District fixed effects | yes | yes | no | yes | yes | no | yes | yes | no | yes | yes | no |
| City fixed effects | no | no | yes | no | no | yes | no | no | yes | no | no | yes |
| Sample: | | | | | | | | | | | | |
| Full sample | yes | no | no | yes | no | no | yes | no | no | yes | no | no |
| Only districts > 15% | no | yes | no | no | yes | no | no | yes | no | no | yes | no |
| Only cities > 15% | no | no | yes | no | no | yes | no | no | yes | no | no | yes |

Standard errors corrected for clustering at the district level are in parentheses. Critical values for all columns except columns 1, 4, 7, & 10 are from a *t*-distribution with 18 degrees of freedom. Bold coefficients are statistically significant at the 5% level. Bold italic coefficients are statistically significant at the 10% level. See Section IV for a description of the demographic and census variables included in the regressions.

Table 9

Estimates of the effect of middle/junior high school on academic gains using an Inverse Mills Ratio correction or under varying missing data assumptions

| | Math | | | | | Reading | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) |
| Panel A: Inverse Mills Ratio | | | | | | | | | | |
| Middle/junior high school | **-0.125** | **-0.131** | **-0.140** | **-0.186** | **-0.194** | **-0.072** | **-0.065** | **-0.055** | **-0.078** | **-0.107** |
| | (0.027) | (0.030) | (0.031) | (0.029) | (0.033) | (0.020) | (0.016) | (0.028) | (0.023) | (0.026) |
| Lambda | **-0.422** | **-0.422** | **-0.421** | 0.491 | 0.602 | **0.209** | ***-0.250*** | ***-0.261*** | 0.643 | 0.328 |
| | (0.193) | (0.193) | (0.174) | (0.509) | (0.617) | (0.042) | (0.134) | (0.138) | (0.446) | (0.471) |
| Panel B: Bounds | | | | | | | | | | |
| Lower | -0.027 | -0.045 | -0.014 | ***-0.063*** | **-0.107** | **0.070** | 0.005 | 0.063 | -0.009 | -0.041 |
| | (0.038) | (0.028) | (0.038) | (0.032) | (0.028) | (0.022) | (0.020) | (0.045) | (0.027) | (0.034) |
| Mean + 0.25 SD | **-0.139** | **-0.160** | **-0.138** | **-0.164** | **-0.187** | -0.027 | **-0.108** | ***-0.064*** | **-0.101** | **-0.115** |
| | (0.036) | (0.028) | (0.035) | (0.032) | (0.029) | (0.018) | (0.019) | (0.036) | (0.024) | (0.029) |
| Mean + 0.10 SD | **-0.144** | **-0.152** | **-0.133** | **-0.159** | **-0.185** | ***-0.030*** | **-0.105** | ***-0.063*** | **-0.100** | **-0.116** |
| | (0.036) | (0.028) | (0.034) | (0.031) | (0.028) | (0.018) | (0.019) | (0.035) | (0.024) | (0.028) |
| Mean - 0.10 SD | **-0.147** | **-0.154** | **-0.135** | **-0.161** | **-0.187** | ***-0.033*** | **-0.107** | ***-0.065*** | **-0.102** | **-0.118** |
| | (0.036) | (0.028) | (0.034) | (0.031) | (0.028) | (0.018) | (0.019) | (0.035) | (0.024) | (0.028) |
| Mean - 0.25 SD | **-0.153** | **-0.167** | **-0.147** | **-0.175** | **-0.198** | **-0.040** | **-0.115** | **-0.072** | **-0.111** | **-0.125** |
| | (0.036) | (0.028) | (0.035) | (0.032) | (0.028) | (0.018) | (0.019) | (0.036) | (0.025) | (0.028) |
| Upper | **-0.272** | **-0.204** | **-0.210** | **-0.250** | **-0.272** | **-0.170** | **-0.155** | **-0.141** | **-0.172** | **-0.188** |
| | (0.040) | (0.034) | (0.040) | (0.034) | (0.027) | (0.022) | (0.023) | (0.035) | (0.026) | (0.020) |
| Control variables: | | | | | | | | | | |
| Student/school/census | no | yes | yes | yes | yes | no | yes | yes | yes | yes |
| District fixed effects | no | no | yes | yes | no | no | no | yes | yes | no |
| City fixed effects | no | no | no | no | yes | no | no | no | no | yes |
| Sample: | | | | | | | | | | |
| Full sample | yes | yes | yes | no | no | yes | yes | yes | no | no |
| Only districts > 15% | no | no | no | yes | no | no | no | no | yes | no |
| Only cities > 15% | no | no | no | no | yes | no | no | no | no | yes |

Standard errors corrected for clustering at the district level are in parentheses. Critical values for columns 4, 5, 9 & 10 are from a *t*-distribution with 18 degrees of freedom. Bold coefficients are statistically significant at the 5% level. Bold italic coefficients are statistically significant at the 10% level. See Section IV for a description of the demographic and census variables included in the regressions.

Table 10

Estimates of the effect of middle/junior high school on longer run academic outcomes

| | English 10 exam | | | English 12 exam | | | H.S. graduation | | | GPA | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) | (12) |
| Panel A: OLS | | | | | | | | | | | | |
| Middle/junior high school | **-0.041** | **-0.052** | **-0.039** | ***-0.061*** | **-0.085** | **-0.064** | **-0.027** | **-0.040** | **-0.030** | -0.030 | ***-0.038*** | **-0.074** |
| | (0.020) | (0.016) | (0.016) | (0.037) | (0.037) | (0.024) | (0.012) | (0.011) | (0.014) | (0.018) | (0.019) | (0.020) |
| Panel B: 2SLS | | | | | | | | | | | | |
| Middle/junior high school | **-0.103** | **-0.118** | ***-0.088*** | ***-0.164*** | ***-0.221*** | -0.111 | 0.037 | -0.032 | 0.035 | -0.051 | -0.044 | **-0.170** |
| | (0.046) | (0.032) | (0.044) | (0.093) | (0.114) | (0.084) | (0.032) | (0.028) | (0.020) | (0.047) | (0.069) | (0.065) |
| Number of observations | 162735 | 40414 | 26001 | 81481 | 19647 | 12620 | 71479 | 18317 | 11469 | 58232 | 14516 | 9065 |
| Control variables: | | | | | | | | | | | | |
| Student/school/census | yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | yes |
| District fixed effects | yes | yes | no | yes | yes | no | yes | yes | no | yes | yes | no |
| City fixed effects | no | no | yes | no | no | yes | no | no | yes | no | no | yes |
| Sample: | | | | | | | | | | | | |
| Full sample | yes | no | no | yes | no | no | yes | no | no | yes | no | no |
| Only districts > 15% | no | yes | no | no | yes | no | no | yes | no | no | yes | no |
| Only cities > 15% | no | no | yes | no | no | yes | no | no | yes | no | no | yes |

Standard errors corrected for clustering at the district level are in parentheses. Critical values for all columns except columns 1, 4, 7, & 10 are from a *t*-distribution with 18 degrees of freedom. Bold coefficients are statistically significant at the 5% level. Bold italic coefficients are statistically significant at the 10% level. See Section IV for a description of the demographic and census variables included in the regressions. The F-statistics for the first stage regressions range from 21 to 66.

Table 11
Effect of moving schools on test score gains from grade 4 to grade 7

| | Math | | | Reading | | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| Panel A: Movers | | | | | | |
| Changed schools | **-0.057** | **-0.038** | **-0.050** | **-0.047** | **-0.044** | **-0.051** |
| | (0.008) | (0.010) | (0.014) | (0.008) | (0.012) | (0.017) |
| Panel B: Movers due to school closing | | | | | | |
| Changed schools | 0.031 | 0.026 | 0.038 | 0.029 | 0.015 | 0.043 |
| | (0.019) | (0.022) | (0.031) | (0.017) | (0.025) | (0.035) |
| Number of observations | 185170 | 47264 | 29935 | 185170 | 47264 | 29935 |
| Control variables: | | | | | | |
| Student/school/census variables | yes | yes | yes | yes | yes | yes |
| District fixed effects | yes | yes | no | yes | yes | no |
| City fixed effects | no | no | yes | no | no | yes |
| Sample: | | | | | | |
| Full sample | yes | no | no | yes | no | no |
| Only districts > 15% | no | yes | no | no | yes | no |
| Only cities > 15% | no | no | yes | no | no | yes |

Standard errors corrected for clustering at the district level are in parentheses. Critical values for columns 2, 3, 5 & 6 are from a *t*-distribution with 18 degrees of freedom. Bold coefficients are statistically significant at the 5% level. Bold italic coefficients are statistically significant at the 10% level. See Section IV for a description of the demographic and census variables included in the regressions.

Appendix Table 1

Estimates of the effect of middle/junior high school on academic gains using an Inverse Mills Ratio correction or under varying missing data assumptions for longer run outcomes

| | English 10 exam | | | English 12 exam | | | H.S. graduation | | | GPA | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) | (12) |
| Panel A: Inverse Mills Ratio | | | | | | | | | | | | |
| Middle/junior high school | **-0.041** | **-0.052** | **-0.040** | ***-0.061*** | **-0.085** | **-0.064** | **-0.027** | **-0.040** | **-0.030** | ***-0.030*** | **-0.038** | **-0.073** |
| | (0.020) | (0.016) | (0.016) | (0.037) | (0.037) | (0.024) | (0.012) | (0.011) | (0.014) | (0.018) | (0.019) | (0.020) |
| Lambda | 0.037 | -0.281 | -0.262 | **1.227** | **0.563** | **1.034** | **-2.946** | -1.290 | 1.405 | **1.227** | **1.275** | **1.296** |
| | (0.343) | (0.531) | (0.538) | (0.210) | (0.211) | (0.328) | (0.967) | (1.362) | (2.042) | (0.243) | (0.417) | (0.436) |
| Panel B: Bounds | | | | | | | | | | | | |
| Lower | **-0.843** | **-0.824** | **-0.732** | **-2.415** | **-2.433** | **-2.274** | **-0.061** | **-0.069** | **-0.057** | **-0.723** | **-0.728** | **-0.738** |
| | (0.062) | (0.065) | (0.049) | (0.113) | (0.120) | (0.099) | (0.011) | (0.011) | (0.015) | (0.066) | (0.070) | (0.069) |
| Mean - 0.25 SD | **-0.047** | **-0.058** | **-0.047** | **-0.089** | **-0.112** | **-0.100** | **-0.031** | **-0.043** | **-0.036** | **-0.053** | **-0.059** | **-0.086** |
| | (0.019) | (0.015) | (0.015) | (0.027) | (0.028) | (0.019) | (0.011) | (0.011) | (0.015) | (0.016) | (0.016) | (0.016) |
| Mean - 0.10 SD | **-0.042** | **-0.052** | **-0.041** | **-0.061** | **-0.082** | **-0.071** | **-0.029** | **-0.041** | **-0.033** | **-0.033** | **-0.039** | **-0.066** |
| | (0.019) | (0.015) | (0.015) | (0.027) | (0.029) | (0.019) | (0.011) | (0.011) | (0.014) | (0.016) | (0.016) | (0.017) |
| Mean + 0.10 SD | -0.032 | **-0.042** | **-0.032** | -0.022 | -0.041 | -0.032 | **-0.026** | **-0.039** | **-0.031** | -0.007 | -0.012 | **-0.038** |
| | (0.019) | (0.015) | (0.015) | (0.028) | (0.030) | (0.018) | (0.011) | (0.011) | (0.014) | (0.016) | (0.017) | (0.018) |
| Mean + 0.25 SD | -0.024 | **-0.033** | -0.025 | 0.008 | -0.010 | -0.002 | **-0.024** | **-0.037** | **-0.029** | 0.014 | 0.010 | -0.017 |
| | (0.019) | (0.016) | (0.015) | (0.028) | (0.030) | (0.018) | (0.012) | (0.011) | (0.014) | (0.017) | (0.019) | (0.019) |
| Upper | **0.732** | **0.677** | **0.639** | **2.283** | **2.244** | **2.138** | 0.003 | -0.010 | -0.001 | **0.663** | **0.650** | **0.616** |
| | (0.071) | (0.067) | (0.054) | (0.131) | (0.151) | (0.119) | (0.013) | (0.012) | (0.013) | (0.065) | (0.074) | (0.079) |
| Control variables: | | | | | | | | | | | | |
| Student/school/census | yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | yes |
| District fixed effects | yes | yes | no | yes | yes | no | yes | yes | no | yes | yes | no |
| City fixed effects | no | no | yes | no | no | yes | no | no | yes | no | no | yes |
| Sample: | | | | | | | | | | | | |
| Full sample | yes | no | no | yes | no | no | yes | no | no | yes | no | no |
| Only districts > 15% | no | yes | no | no | yes | no | no | yes | no | no | yes | no |
| Only cities > 15% | no | no | yes | no | no | yes | no | no | yes | no | no | yes |

Standard errors corrected for clustering at the district level are in parentheses. Critical values for all columns except columns 1, 4, 7, & 10 are from a *t*-distribution with 18 degrees of freedom. Bold coefficients are statistically significant at the 5% level. Bold italic coefficients are statistically significant at the 10% level. See Section IV for a description of the demographic and census variables included in the regressions.

Appendix Table 2

Estimates of the effect of middle/junior high school on longer run academic outcomes conditional on grade 7 test scores

| | English 10 exam | | | English 12 exam | | | H.S. graduation | | | GPA | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) | (12) |
| Panel A: OLS | | | | | | | | | | | | |
| Middle/junior high school | -0.018 | -0.022 | 0.001 | -0.035 | -0.054 | -0.023 | **-0.024** | **-0.035** | -0.023 | -0.024 | -0.030 | **-0.058** |
| | (0.023) | (0.018) | (0.016) | (0.042) | (0.043) | (0.024) | (0.011) | (0.011) | (0.015) | (0.020) | (0.021) | (0.019) |
| Panel B: 2SLS | | | | | | | | | | | | |
| Middle/junior high school | ***-0.078*** | **-0.097** | -0.057 | -0.124 | -0.196 | -0.077 | 0.040 | -0.032 | 0.037 | -0.044 | -0.043 | **-0.162** |
| | (0.043) | (0.035) | (0.045) | (0.097) | (0.125) | (0.091) | (0.033) | (0.030) | (0.021) | (0.045) | (0.070) | (0.064) |
| Number of observations | 162735 | 40414 | 26001 | 81481 | 19647 | 12620 | 71479 | 18317 | 11469 | 58232 | 14516 | 9065 |
| Control variables: | | | | | | | | | | | | |
| Student/school/census | yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | yes |
| District fixed effects | yes | yes | no | yes | yes | no | yes | yes | no | yes | yes | no |
| City fixed effects | no | no | yes | no | no | yes | no | no | yes | no | no | yes |
| Sample: | | | | | | | | | | | | |
| Full sample | yes | no | no | yes | no | no | yes | no | no | yes | no | no |
| Only districts > 15% | no | yes | no | no | yes | no | no | yes | no | no | yes | no |
| Only cities > 15% | no | no | yes | no | no | yes | no | no | yes | no | no | yes |

Standard errors corrected for clustering at the district level are in parentheses. Critical values for all columns except columns 1, 4, 7, & 10 are from a *t*-distribution with 18 degrees of freedom. Bold coefficients are statistically significant at the 5% level. Bold italic coefficients are statistically significant at the 10% level. See Section IV for a description of the demographic and census variables included in the regressions. The F-statistics for the first stage regressions range from 21 to 66.

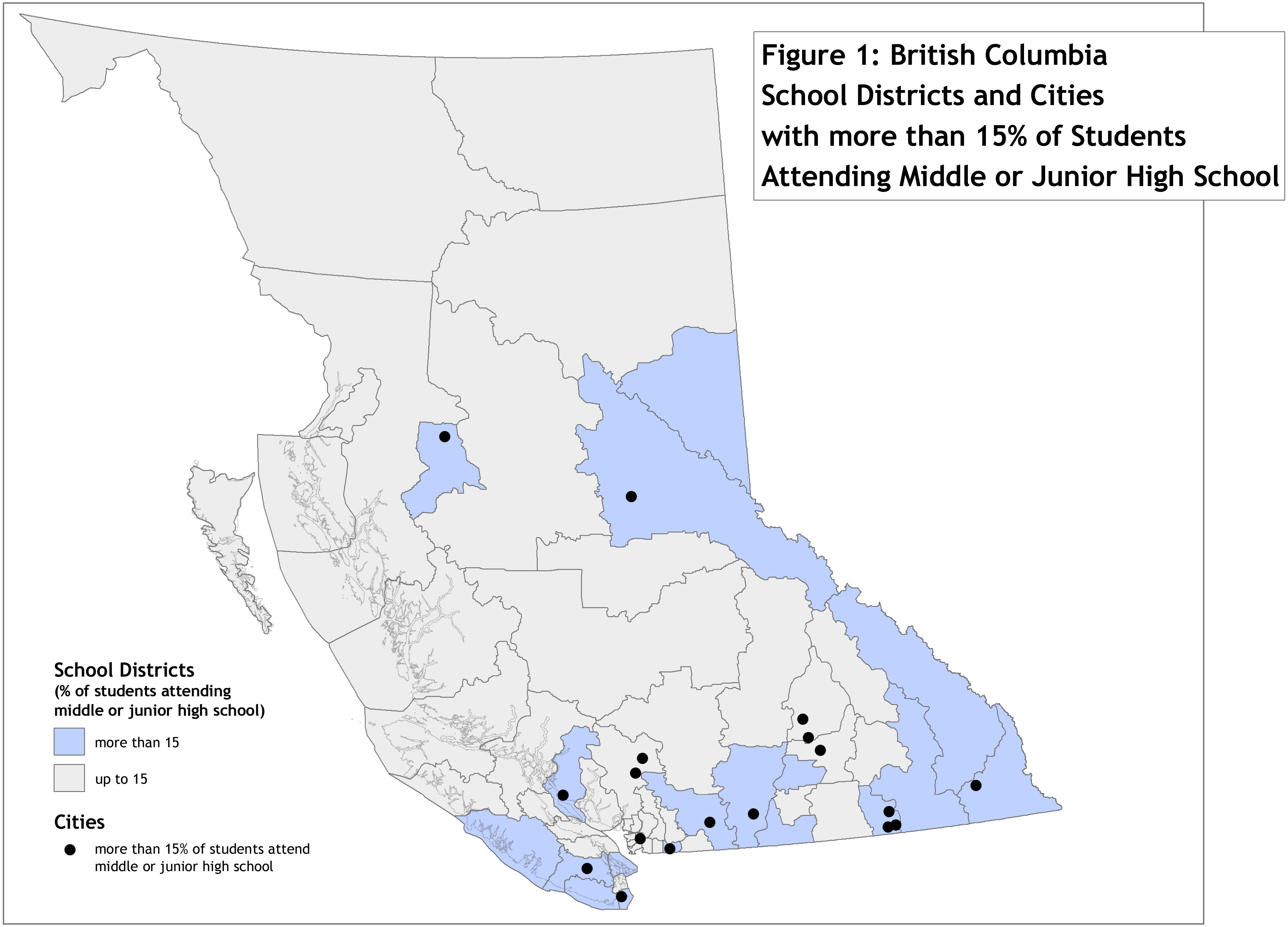

Figure 1: British Columbia
School Districts and Cities
with more than 15% of Students
Attending Middle or Junior High School
School Districts
(% of students attending
middle or junior high school)
more than 15
up to 15
Cities
more than 15% of students attend
middle or junior high school