Does Greater School Autonomy Make a Difference? Evidence from a Randomized Natural Experiment in South Korea[*]

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We study the effects of school autonomy using a randomized natural experiment in Seoul. Private and public high schools subject to the equalization policy in Seoul admit students assigned randomly to them, receive equal government funding, charge identical fees, and use similar curricula, while private schools have greater flexibility in personnel decisions, and their principals and teachers face stronger incentives to perform. We find that private high schools have fewer violent incidents per student, a higher four-year college entrance rate, and better average test scores. Our analysis suggests that autonomy in personnel decisions explains the positive student outcomes in private schools.

JEL codes: I21, I22, J24

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1. INTRODUCTION

A large body of literature in economics, education, and sociology shows that students attending private schools outperform students attending traditional public schools across a range of outcomes. As private schools' autonomy from school district offices and their incentives to deliver good student outcomes can be replicated in the public school system, these findings strengthen initiatives to provide public schools with greater autonomy, while ensuring that the incentives for their principals and teachers to perform are strong. The establishment of charter public schools in the United States, free schools in the United Kingdom, independent public schools in Australia, and community-managed schools in many developing countries are some of these examples. However, there is sparse evidence on the causal effects of school autonomy on student outcomes.

Although some studies based on the random assignment of private school vouchers or oversubscribed charter school slots to low-income applicants show positive effects of attending these schools on student outcomes, it remains uncertain which precise aspects of these schools explain the differences in outcomes.[1] When past studies compare the outcomes between the randomly selected receivers and non-receivers of private school vouchers or charter school slots, the estimated effects not only reflect differences in school autonomy, but also capture the differences in student composition, peer quality, resources, and other dimensions of school quality between the highly sought-after schools and

[1] Earlier observational studies, such as Coleman et al. (1982), Alexander and Pallas (1985), and Coleman and Hoffer (1987) find that private schooling is more effective in raising student achievement (test scores) than public schooling in the U.S., even after controlling for the factors that jointly influence private school choice and achievement. More recent studies by Figlio and Stone (1999), Vandenberghe and Robin (2004), Krueger and Zhu (2004), and Altonji et al. (2005a, 2005b), however, show mixed effects of private and charter public schooling on achievement. On the other hand, observational studies focusing on the effects of private or Catholic schooling on high school completion and college attendance, such as Evans and Schwab (1995), Neal (1997), Altonji et al. (2005a), and Vella (1999), consistently show positive effects of private schooling.

the default traditional public schools (e.g., Peterson et al. 2003; Angrist et al. 2002, Angrist et al. 2006; Hoxby and Murarka 2009; and Abdulkadiroglu et al. 2011).

Past studies that focus on school autonomy also face the difficulty of isolating its effects from other potential confounds. For instance, Clark (2009) uses a regression discontinuity design to examine the effect of a 1988 United Kingdom reform that permitted British public high schools to opt out of local authority control if they won majority votes among parents. However, as the reform was introduced together with nationwide open enrollment, resources tied to enrollment, and the publication of school performance to ensure increased competitiveness of public schools, achievement gain from the increased autonomy is potentially confounded by the competition effect and changes in student composition across schools. On the other hand, using cross-country panel data, Hanushek et al. (2013) find that an increase in school autonomy is positively associated with student achievement in countries with strong institutions, while it is negatively associated with student achievement in countries with weak institutions. Thus, it is unclear whether increased school autonomy alone will necessarily lead to better student outcomes.

In this paper, we exploit a randomized natural experiment in Seoul, South Korea, which provides us with a unique policy setting that is close to an ideal randomized controlled experiment for evaluating the causal effects of school autonomy. Since the 1970s, the Korean government has implemented what the country calls its "equalization policy" and a lottery-based student enrollment system in Seoul. High schools governed by the equalization policy have several important features. First, the schools subject to the policy, whether privately owned or publicly owned (hereafter private or public schools), receive equal government funding, charge the same fees, and follow the same national curriculum. Second, private schools maintain autonomy over their personnel decisions, while public schools do not. For example, the owner or board of

directors of each private school appoints the school principal, who in turn makes decisions on hiring and promoting teachers. In contrast, public school principals or teachers are recruited by the Seoul Metropolitan Office of Education and rotate to a different high school every four years. Third, students are assigned randomly into equalization policy schools within their school districts.[2] Schools and students have no control over admission and enrollment decisions. Although motivated parents may choose to live in a neighborhood with high-quality schools, they do not have control over which schools—private or public schools—their children attend within the school district. Students are generally not allowed to transfer to another school within the same school district. When students and their families move to another school district, they are reassigned randomly to a school in the new district (Kang 2007). This setting contrasts with other countries, where randomization may be applied only to schools that face excess demand and to students who express school preferences through enrollment applications.

The equalization policy in Seoul removes differences in factors commonly attributed to the positive effects of private and other forms of independent schooling. We show evidence that autonomy that is unique to private schools is reflected in differences in resource allocations, incentive structures, and teacher compositions between private and public schools. Although the equalization policy itself does not impose greater accountability on private schools, principals and teachers in private schools face lesser job security and higher incentives to deliver good student outcomes. We find that private schools are more likely to hold their principals accountable on quantifiable student outcomes, have a higher share of teachers employed on short-term contracts, and have a more heterogeneous workforce. In addition, the data suggest that private schools have a

[2] There are special-purpose and autonomous high schools operating outside the equalization policy. These schools recruit students based on their academic performance before other students are assigned randomly into equalization policy high schools. Section 2 describes various types of high schools in more detail.

greater component of performance pay for teacher compensation and larger teacher salary dispersions, but they also spend less per student, run larger classes, and have fewer experienced and highly-educated teachers. Thus, it is an empirical question of whether private schools causally improve student outcomes.

We find that private school students in Seoul are no more likely than public school students to drop out of and graduate from high school, but they are 4.4 percentage points more likely to attend colleges and 60 percent less likely to be involved in violent incidents. In particular, the increase in college attendance rates is driven by the increase in four-year college attendance rates and the decrease in two-year junior college attendance rates. We also find that private school students outperform public school students in the National Assessment of Educational Achievement (NAEA) tests, a national standardized examination administered to students in their second year of high school (i.e., equivalent to eleventh graders in other countries), by roughly 0.12 standard deviations.

We further rule out longer history of private schools, single-sex schooling, religious affiliation of private schools, and private tutoring as potential channels of the positive private school effects in Seoul. Our analysis suggests that the private school effects channel through the differences in within-school dispersions of teacher salary and teacher types (e.g., teachers with different years of experience). Specifically, dispersions benefit students in private schools but hurt those in public schools. The dispersions in salary and types of teachers in public schools are likely driven by the public school teacher rotation system. Rotating teachers across schools regularly may not only disrupt learning, but also reduce the incentives for teachers to build school-specific human capital. Taken together, the policy experiment in Seoul indicates that giving schools more autonomy in personnel decisions, while incentivizing their principals and teachers to perform well, will benefit students.

2. SECONDARY SCHOOLS AND EQUALIZATION POLICY IN SEOUL

Concerned about the adverse effects of competitive high school entrance examinations, rampant private tutoring, corruption, and large differences in peer quality across schools, the Korean government first implemented the "equalization policy" among high schools in Seoul and Pusan in 1974. In Korea, primary education spans six grade levels, and secondary education comprises three years of middle school and three years of high school study. The equalization policy in Seoul removed the competitive high school entrance examination and introduced random assignment of students across schools within school districts.

In 2008, there were 208 high schools (over 11 school districts in Seoul) that were subject to the equalization policy. These schools can be privately owned or publicly owned and coeducational or single-sex. Private schools can be religiously affiliated or secular. Students must attend the randomly assigned high schools even if the religious affiliation of the school differs from theirs.[3]

Though parents cannot select their preferred equalization policy high schools to enroll their children, they have choices outside these equalization policy schools. The government permits roughly 20 selective high schools in Seoul to operate outside the equalization policy and have priority in student selection. These selective schools are either special-purpose high schools that specialize in sciences, sports, arts, music, and foreign languages, or autonomous high schools.[4] These schools select their own students based on their academic performance, may charge higher tuition, and enjoy a greater level of autonomy in designing and implementing their own school curriculum than private schools

[3] We confirmed with the Seoul Metropolitan Office of Education and a religious teacher in a private high school that religion of parents and their children is not considered in the assignment during our sample period. In religious private schools, there are religious teachers, services and classes, but students are usually given the choice to participate in religious classes and services.

[4] The majority of special-purpose high schools were private and established after the 1970s, while autonomous schools were introduced in 2010.

bound by the equalization policy (Paik 2013). They offer choices to families with strong preferences for school quality. Students can opt for these selective high schools before being subject to the lottery-based enrollment system, but they have to attend a randomly assigned equalization policy high school if they fail to enter a selective high school. Thus, special-purpose and autonomous high schools function more like the typical private high schools in other countries, while the equalization policy private schools are essentially government funded schools with some school autonomy.

[Figure I]

In Seoul, after special-purpose and autonomous high schools admit their students (roughly 5% of high school students in Seoul), the rest of the students are assigned randomly into different general academic high schools within the 11 school districts (Figure I). Because population density in Seoul is high (10 million people in an area of 605 square kilometers), students do not need to travel far to attend one of the several equalization policy high schools within their school districts.[5] Prior to 2010, new entrants into equalization policy high schools were assigned randomly into schools unconditional on any potential school preferences they had within school districts, but since 2010, school districts have partly taken into account preferences indicated by middle school students and their parents.[6] As we are interested in examining the causal effects of school autonomy, we

[5] For comparison, population density in Chicago (2.7 million people in an area of 606 square kilometers) is roughly 30 percent of that in Seoul and population density in New York City (8.9 million people in an area of 1219 square kilometers) is roughly 40 percent of that in Seoul.

[6] One school district made up by the Jongno-gu, Jung-gu, and Yongsan-gu administrative districts practiced conditional randomization prior to 2010, as this is a central district in Seoul with few residents living in the area. We confirmed with the Seoul Metropolitan Office of Education that for our sample period, stated school preferences or any other factors (such as distance to school and siblings) were not considered in the randomization process in all other school districts. We show that the results are not sensitive to dropping this school district in an appendix (Table A1).

focus only on general academic high schools that operate under the equalization policy and students who were admitted prior to 2010 when school choice had been more restricted.

With the introduction of the equalization policy in the 1970s, all historical private schools were added into the existing system of centralized public school finance in Korea. Several commonalities were introduced into public and private schools, such as uniform and centralized policies over fees and tuition, curricula, teachers' salary scales (40 scales), and teachers' qualification.[7] As private schools are not allowed to charge higher tuition fees than public schools, the government fully funds teacher salaries and operating expenditures based on the standard budget required for equivalent public schools (Paik 2013). Although the tuition fees that private and public schools charge are low, families who cannot afford the fees are exempted from paying them. Teachers must instruct students in accordance with the unified national curriculum, based on designated or certified textbooks (Kim et al. 2007). Both private and public school teachers are guaranteed equivalent salary schedules based on their experience and qualifications, but private schools have more flexibility in promoting teachers from short-term contract teachers to regular teachers and from regular teachers to high-paying senior administrative positions (e.g., vice principals) on the basis of their performance. All high school teachers must be graduates from teacher's colleges or fulfill specific course requirements for teachers, but public school teachers must also pass the national teacher recruitment examination, as they are considered to be government employees.

Both public and private equalization policy high schools are heavily regulated to operate in similar manners, but they differ in the level of autonomy.

[7]According to the legislation on school tuition fees and admission fees, the annual tuition fee in 2009 for both public and private high schools was set at about 1,300 USD (1.45 million KRW). The admission fee was less than 15 USD or 14,100 KRW (Source: http://www.law.go.kr).

All school principals in Seoul are selected among those with a certificate for principal eligibility. Principals of public schools in Seoul are appointed by the Seoul Metropolitan Office of Education, while those of private schools are appointed by the owner or board of directors of the school. The board of directors determines the appointment and term extension of principals.[8] Private school principals recommend whom they hire as teachers and the length of the teachers' contracts (i.e., short-term teachers or regular teachers) to the board of directors for approval. Public school principals and teachers are government employees recruited by the Seoul Metropolitan Office of Education and they must rotate to different schools every four years. Also, public school principals can work as regular teachers after their term as a principal ends (i.e., guaranteed employment although at a lower level), but private school principals are not guaranteed a position after their term of employment ends.[9] Thus, the greater discretion in staffing decisions of private schools means that private school principals and teachers generally face less job security compared to public school principals and teachers. We provide more evidence on how private and public high schools differ along these dimensions in the next section.

Principals in both public and private schools have control over their daily operations and how they allocate their overall budget and resources. For example, principals in both private and public schools can decide how they organize their classrooms and teachers. Public school principals, however, have little control over their staffing decisions, while private school principals have autonomy over their staffing decisions. If private school principals can organize their schools more effectively with the higher level of autonomy and stronger incentives to perform, they may be better in delivering good student outcomes.

[8] Private School Law, Korea Ministry of Government Legislation (Source: http://www.law.go.kr).
[9] Public school principals can have two 4-year terms (maximum 8 years), while private school principals' terms can be renewed without limit.

School board members can be paid a salary as a part of the operating expenditures. However, the scope for such salary payment is limited and usually only one or two permanent directors of the board are paid a salary. Although good academic performance may not financially benefit the school owner and board members, delivering good student outcomes may help their reputation as community leaders and be in line with their educational philosophies. In addition, the Ministry of Education, Technology and Science monitors the operation and performance of schools, and may intervene if private schools are poorly managed and the educational outcomes of students suffer.

3. DATA

3.1. Description

The data used in this paper are drawn from several sources. First, we use publicly disclosed school-level information pertaining to enrollment, dropouts, transfers, graduates' destinations, number of teachers, incidents of violence, expenditures, and other administrative records from the Ministry of Education, Technology and Science's (METS) website.[10] Second, we use data on individual eleventh graders' performance in the NAEA administered in 2010 from the Korea Institute for Curriculum and Evaluation (KICE).[11] Unlike the College Scholastic Aptitude Test (CSAT), which is a national standardized test used for college admission, the NAEA is a relatively low-stakes test designed by the KICE to identify factors affecting student achievement. The NAEA data also provide some

[10] The data were available at www.schoolinfo.go.kr, the Ministry of Education, Technology and Science's website in 2011. We also verify the data with those collected by the Korea Education and Research Information Service (http://edudata.keris.or.kr). We also obtain administrative-district-level information of number of teachers by pay grade, year, and type of school from the Seoul Metropolitan Office of Education's website, www.sen.go.kr.

[11] Source: http://www.kice.re.kr. We also have tenth graders' NAEA data for 2008 and 2009, but the 2008 sample is a 5% random sample and the 2009 sample reports test results in categorical grades. Because the 2008 sample contains more information in the student survey, we also use it when we verify randomization.

student and school survey information that is useful for our analysis. Among the universe of equalization policy high schools in Seoul, we focus on 198 general academic schools that have data available for all of the key outcome variables between 2008 and 2010.[12] Last, we surveyed 122 high school principals in 2013 to obtain information about their perceptions regarding differences between public and private schools.[13] Except for our own survey data, all data used in this paper are administrative data, so we have information for the universe of schools (school-level data) and test-takers (student-level data) in Seoul.

[Table I]

Table I provides the distribution of equalization policy high schools by school district and type. Nearly two thirds of the high schools are privately owned. About 30 percent of the private schools are religiously affiliated, with the majority (90 percent) Christian (Appendix Table A2). Coeducational, all-boys, and all-girls schools are roughly one third each.

Table II shows summary statistics of students' characteristics by private and public schools. Panel A indicates that school-level student characteristics are similar between private and public schools. Similarly, panel B indicates that grade 11 students who took the NAEA tests live in similar types of households. Thus, even before taking into account that randomization is done within school districts, we already see that predetermined student characteristics are similar between private and public schools. Panel C shows that school-level student outcomes,

[12] We exclude 6 schools that were newly established and had no senior (grade 12) students' data throughout the period 2008 to 2010 and also 4 schools that changed their academic type to special or autonomous in 2010.

[13] Out of the 198 high schools sampled in this paper, we excluded in the survey 25 schools that changed their school type from general academic to autonomous school after 2010. Among the 173 school principals to whom we sent survey questionnaires, 122 responded, and the response rates do not differ between private and public schools.

such as dropout rate and seniors' graduation rate, are similar between private and public schools, while college attendance rates are higher and violent incidents per student are lower in private schools. Panel D shows that grade-11 private school students tend to perform better in NAEA tests.

[Table II]

3.2. Verification of Random Assignment

If randomization is strictly enforced in the high schools within districts in Seoul, then the final school assignments should not be correlated with any predetermined characteristics of students and parents after controlling for school district fixed effects. We verify random assignment by regressing predetermined characteristics of students against a private school indicator and a set of school district fixed effects. School district fixed effects are included, because randomization is implemented within districts. For variables that are available for multiple years, we include a set of school district year fixed effects, rather than school district fixed effects.

We have a set of predetermined student characteristics, covering a range of socio-economic status. These variables include whether a student lives in a single-mother household, whether a student lives in a dual-parent household, the share of students on public welfare support (a proxy for poverty), the share of ethnic minority students, and the share of students receiving school lunch support (a proxy for low income). Although transferring is uncommon and the students who transfer to another school district are subject to random assignment again, we also examine whether the net transfer rate is different between private and public

schools.[14] If randomization is strictly enforced, the coefficient for the private school indicator should not be statistically different from zero.

[Table III]

Columns 1 to 3 in the top panel of Table III show that the likelihood of a student being in a family on welfare assistance, an ethnic minority, and on lunch support is similar between private and public schools. Column 4 in the top panel indicates that net transfer rates do not differ across school types.[15] Columns 1 to 4 in the bottom panel show that the likelihood of a student coming from a single-mother or dual-parent household is similar between private and public school students. The coefficient estimates of the private school effect in all cases are close to zero and their signs do not show a systematic pattern, consistent with what the randomized allocations would imply. Table III also indicates that these predetermined characteristics are highly correlated with the student test scores. Thus, our tests for randomization imply that a student's private school attendance status is orthogonal to their predetermined influences of outcomes.

As further checks for balance, we supplement our tests for randomization using additional student-level data from the NAEA 2008 grade-10 student survey and the Korean Education and Employment Panel's (KEEP) middle school

[14] The information about student transfers and percentage of students on lunch support came from METS's school-level data for 2008–2010 available at www.schoolinfo.go.kr; the percentage of students on welfare assistance and the percentage of ethnic minority students of each school is sourced from the principal survey accompanying the 2010 NAEA; and the information about a student's parental characteristics is sourced from the student survey accompanying the 2010 NAEA.

[15] This result is not too surprising, as individuals with strong preferences for school quality would have opted for selective high schools before being subject to the randomization. Moreover, the differences between private and public high schools are fairly subtle to most individuals, so there is no obvious reason for non-compliance. Indeed, some of us who attended equalization policy high schools did not know our school type until working on this paper.

student sample.[16] Though we examine outcomes of grade-10 students surveyed in NAEA 2008 (who later became high school seniors in 2010), the disadvantage of NAEA 2008 is that it includes only a 5% random sample of students and we cannot directly correlate students' predetermined characteristics with the outcome measures that we analyze. The problem of KEEP is that it lacks school district information and has a very small number of observations in Seoul. Consequently, we only report the results in an appendix (Table A3). The results indicate that there is no systematic difference in the predetermined characteristics of students across school types.

4. EVIDENCE OF GREATER AUTONOMY AND INCENTIVES TO PERFORM IN PRIVATE SCHOOLS

Panel A in Table IV reports average school characteristics by school type. It shows that private and public high schools differ significantly in their distribution of teacher types and resource allocation. Although funding available per student is equivalent across schools under the equalization policy, private schools spend marginally less on teachers and staff on a per student basis. They hire fewer teachers per student, keep a larger fraction of their teachers on short-term contracts, employ a lower fraction of teachers with an advanced certificate (a proxy for teaching experience), and have relatively fewer teachers with a graduate degree. The differences are mainly in staffing decisions, rather than in the quality of infrastructure and the use of ability tracking.[17] The observable characteristics in private schools may have adverse effects on students, if there is no incentive for

[16] The advantage of KEEP is that it follows a set of middle school students into their high schools, so correlates of students' high school educational outcomes, such as percentile rank of academic performance, whether receiving any disciplinary action, whether often absent from school, and average monthly household income in the middle school, are available.

[17] Some past studies indicate that student outcomes improve with better school infrastructure (Branham 2004 and Glewwe et al. 2011) and the use of ability tracking (Duflo et al. 2011).

their principals and teachers to deliver good student outcomes.[18] More importantly, the larger variations in the characteristics and spending on teachers for private schools than for public schools are consistent with the extent of autonomy that private schools enjoy.

[Table IV]

Since private school principals are directly responsible for the recruitment and selection of teachers, they can more flexibly recruit, retain, and promote teachers who are most suitable to deliver the outcomes they desire. Table IV (panel A) shows that private school principals hire a larger fraction of teachers on short-term contracts, who generally face less job security. Short-term contract teachers may be more effective at delivering better student performance, as Duflo et al. (2011) and Muralidharan and Sundararaman (2013) have shown. In private schools, short-term teachers can be promoted to be regular teachers depending on their performance, whereas in public schools, short-term teachers cannot become regular teachers unless they pass a teacher's exam.[19] As a result, short-term teachers in private schools face stronger incentives to deliver better student outcomes, and regular teachers in private schools are more likely to be a selected group of teachers who have proven themselves through on-the-job performance. These teachers, whether short-term or regular, may have characteristics less observable to researchers, which past studies show to be more reflective of teacher quality.

[18] Past findings about class size and teacher credentials are mixed (see Hanushek (2006) for a review of the evidence). More recently, Dobbie and Fryer (2013), using data on charter schools in New York City, show that conventional input measures—class size, per-pupil expenditure, teachers' credentials, and teachers' educational attainment—are not positively correlated with school effectiveness.

[19] Thus, the focus for short-term teachers in public schools is on passing the examination, rather than delivering good student outcomes.

Private schools pay their teachers and staff higher average total financial compensation. The difference is about 3 percent of the average total financial compensation packages of public school teachers and staff (Table IV panel A). The difference is small, but statistically significant. Since Figure II shows that the average base salary of teachers and staff is lower in private schools, the higher average total financial compensation implies that private school teachers and staff receive higher bonuses. The higher bonuses may incentivize them to deliver better student outcomes.

[Figure II]

The dispersion in salary is higher in private schools than in public schools (Table IV). Although private school teachers are guaranteed the same pay-scale schedule as public school teachers who have the same years of teaching and credentials, their likelihood of within-school promotions to a senior high-paying administrative positions (e.g. vice principal) depends more on their performance, while within-school promotions (other than a stepwise increase that comes with teaching experience and credentials) are rare in public schools. Furthermore, private schools hire a higher proportion of short-term contract teachers who tend to be at the bottom end of the salary distribution and have strong incentives to work hard for promotion. The dispersion in salary is also consistent with private schools having larger within-school variance of teachers with an advanced certificate (proxy for experience), as shown in Table IV. As Hamilton et al. (2003) have shown, the heterogeneity in the productivity of team workers may raise average productivity through collaboration and mutual learning of different types of workers. Thus, private schools may have an environment more conducive to delivering good student outcomes.

Private schools set quantifiable accountability measures for their principals. Our survey data (Panel B in Table IV) show that public school principals emphasize more on developing students' creativity, which is generally harder to measure, while private school principals place more emphasis on entrance into a prestigious university, which is relatively easy to measure. They put roughly equal emphasis on good performance in tests and good discipline and behavior.

Our survey data reveal that perceptions of principals about the differences in autonomy, incentives, and accountability between private and public schools are consistent with the administrative data. Item 1 in Table V indicates that principals generally think that private schools enjoy greater autonomy than public schools. Item 2 in Table V shows that the majority of principals (62.7 percent) agree that public school principals face higher job security than private school principals. Table V also shows that principals generally agree that the incentive to produce good academic performance is greater in private schools than in public schools (items 4 to 7). Thus, private school principals focus on delivering good academic outcomes that are quantifiable, as well as facing stronger incentives to do so.

[Table V]

Although private schools have relatively fewer experienced and highly educated teachers and run larger classes, which may have negative effects on student performance, their principals and teachers work in an environment with stronger incentives and more factors to induce better student outcomes. Thus, it is an empirical question whether private schooling leads to better student outcomes.

5. IMPACTS OF PRIVATE SCHOOLING ON STUDENT OUTCOMES

5.1. Drop Out, Graduation, Violence, and College Attendance

We exploit the random assignment of students into schools within school districts to identify the causal effects of private schooling on student outcomes using the following regression specification:

$$y_{jkt} = \beta \cdot Private_{jk} + \delta_{kt} + \epsilon_{jkt}, \quad (1)$$

where y_{jkt} denotes an outcome of students in school *j* of school district *k* in year *t*. The school-level outcome variables include (1) the percentage of students dropping out of high school, (2) the percentage of high school seniors graduating, (3) the number of violent incidents reported per student, (4) the percentage of high school seniors attending any college, (5) the percentage of high school seniors attending two-year colleges, and (6) the percentage of high school seniors attending four-year colleges.[20] As four-year colleges are more academically oriented and generally harder for students to enter than two-year colleges, we examine the two types of college attendance rates separately. $Private_{jk}$ is an indicator for whether school j is privately owned or not. δ_{kt} represents a set of school district year-fixed effects. δ_{kt} includes 33 school district year-fixed effects. As students are assigned randomly into schools within a district, the inclusion of δ_{kt} ensures that the selection into school districts is controlled for and that the coefficient of interest β captures the causal effect of attending a private school on student outcomes. The term ϵ_{jkt} denotes all other unobserved influences of the outcomes. We weight all school-level regressions by the number of students in the denominators of dependent variables.

We report the estimated effects of private schooling on school-level student outcomes in Table VI. The first two columns in Table VI indicate that private school students and public school students are equally likely to drop out of and

[20] Examples of violent incidents are physical violence, bullying, harassment, verbal violence, threat, intimidation, harassment, cyber-bullying, etc.

graduate from high school. As the high school dropout rate is less than two percent and the graduation rate is close to 98 percent in Seoul, there is not much room for improvement in these outcomes.[21] Column 3 in Table VI shows that private school students are less likely to be involved in violent incidents. In particular, private schooling reduces average violent incidents per student by approximately one per 1,000 students. Compared to the average violent incidents per student in public schools, which is 1.5 incidents per 1,000 students, private schooling reduces violent incidents per student by almost 60 percent. This estimate is comparable to the finding by Cullen et al. (2006), which shows that self-reported arrest rates are reduced by nearly 60 percent among the students who win lotteries to attend high-achieving Chicago high schools compared to those who do not. Although violence is an extreme form of behavioral problems and is fairly rare in Korean high schools, having more violent incidents may indicate that other forms of behavioral problems are also pervasive. The fact that private schools have fewer violent incidents per student than public schools suggests that students in private schools tend to have lower levels of other behavioral issues and enjoy safer school environments.

The remaining columns in Table VI show that private schooling increases college attendance rates of high school seniors by moving them into four-year universities and away from two-year junior colleges and other options. Column 4 reports that private schooling significantly increases high school seniors' college attendance rates. The effect is estimated to be 4.4 percentage points or eight percent higher than public schools, where roughly 56 percent of public high school seniors enter colleges. Columns 5 and 6 indicate that private schooling significantly raises the likelihood of four-year college attendance and reduces the likelihood of two-year college attendance. Our estimated effect size is about one

[21] For comparison, the dropout rate of high school students in the U.S. was 7.4 percent in 2010 (Source: http://nces.ed.gov/fastfacts/display.asp?id=16, accessed August 2013).

third of Evans and Schwab's (1995) estimate of the effect of Catholic private schooling. Evans and Schwab (1995) found that Catholic school attendance in the U.S. increases the probability of entering a four-year college by 13 percentage points or 46 percent of the college attendance rate of public school students. However, Neal (1997) shows that the estimated Catholic school effects become smaller when the alternative public schools are more similar, while Altonji et al. (2005a) argue that past estimates are based on potentially problematic instrumental variables. Thus, our estimate is fairly sizable considering the private and public schools in Seoul differ only in school autonomy and students are assigned randomly into schools.

[Table VI]

We report the estimated effect of private schooling on college attendance rates by gender in Table VII. The evidence suggests that private schooling significantly increases the probability of a student attending any college considerably more for males than for females (columns 1 and 4). Columns 2 and 5 show that private schooling increases the likelihood of high school seniors attending four-year colleges by 7.2 percentage points for males and by 4.9 percentage points for females, respectively. As males are less likely to go to four-year colleges than females in public schools, the relative difference that private schooling makes is even greater. Columns 3 and 6 show that private schools reduce the likelihood of high school seniors attending two-year colleges in a similar magnitude across gender, by 2.1 percentage points for males and by 2.7 percentage points for females. Thus, higher overall college attendance rates among males in private schools are mostly driven by the increased likelihood of attending four-year colleges.

[Table VII]

5.2. Impacts on Test Taking and Test Scores

We use individual eleventh graders' test scores in the NAEA in 2010 to assess the effects of private schooling on high school students' achievement. Because the NAEA is relatively low-stakes and students cannot strategically select subjects the way they would do for the College Scholastic Aptitude Test (CSAT), the NAEA test score is a more appropriate measure to reveal whether private schooling improves students' learning.[22] We estimate the effects of private schooling on individual students' test scores in the subjects of Korean, mathematics, or English at the student level. Before estimating the effects of private schooling on test scores, we also check whether private school students and public school students are equally likely to take each test to ensure that the estimates do not suffer from any selection bias.

Columns 1 to 3 in the top panel of Table VIII show that private school students are less likely to miss the NAEA tests by two percentage points, indicating higher absenteeism on the test date among public school students. If there are non-random differences in the selection into test taking between private and public school students, the estimated effects of private schooling based on the sample of students with non-missing test scores will suffer from non-random selection bias. For example, if public schools tend to make the less academically

[22] We prefer to measure students' performance using the NAEA test, as it has fewer strategic components compared to the CSAT. Under the current accountability system in Korea, schools and teachers' incentives are to achieve high college entrance rates, rather than to achieve high mean CSAT scores. Although CSAT scores are weighted heavily in the college application process, a student's in-school performance and choice of college major are also taken into consideration in the admission process. In order to enter into their preferred universities and college majors, students may strategically choose the seven CSAT component subjects through their track selection and selective preparation of certain subjects. Although all students take the same CSAT Korean and English subjects, other test components depend on their tracks and their choice of mathematics and electives. Nevertheless, we also find positive effects of private schooling on CSAT Korean and English scores (see Table A3 in an online appendix).

inclined students miss the test, then the estimated effects of private schooling on the test score will be biased downward.

[Table VIII]

We use two methods to address this concern. First, we replace each missing value by the average test score of the student's type of school in the district. The assumption is that students who missed the tests are similar to the average students of a particular school type in the district. As it is likely that weaker students have higher absenteeism and miss taking the tests, this approach provides conservative estimates of private schooling effects.[23] Second, we use Lee's (2009) sharp-bound estimators to bound the effects of private schooling on test scores. The sharp-bound estimators trim the private school sample on the basis of the selection rate (i.e., the probability of missing the test) of the public school sample relative to that of the private school sample, so that the two samples are comparable. For example, suppose private school students are more likely to take the test. When the upper tail of the private school test score distribution is trimmed, the remaining sample of test takers in private schools is comparable to the sample of test takers in public schools, assuming high performers at the public schools miss the test. The lower-bound estimate of the private school effect is then the difference between the average test score of public school test takers and the average test score of the trimmed sample of private school test takers. Similarly, the upper-bound estimate of the private school effect is obtained by trimming the lower tail of the private school test score distribution and then taking

[23] A simple school-level regression of average NAEA test scores (across subjects) against the share of missing test scores confirms that average test score is positively correlated with the share of missing test scores.

the difference between the average test scores of public test takers and trimmed private school test takers.

[Figure III]

The test score distribution for each test by type of school is shown in Figure III. The top panel shows the test score distributions for Korean, the middle panel shows the test score distributions for mathematics, and the bottom panel shows the test score distributions for English. Overall, the distributions of private school students' test scores are to the right of the distributions of public school students' test scores. Furthermore, it appears that private schooling not only increases the mean test scores, but also reduces the fraction of students falling into the bottom tails of the distributions.

Columns 4 to 6 in Table VIII report the OLS estimates based on the replacement of missing method. Columns 4 to 6 in the bottom panel of Table VIII report the lower-bound and upper-bound estimates of the effects of private schooling on Korean, mathematics, and English test scores. The OLS estimates show that private school students outperform public school students in Korean by 0.13 standard deviations, in math by 0.12 standard deviations, and in English by 0.12 standard deviations. Similarly, the lower sharp-bound estimates are greater than zero, indicating that even in the worst-case scenario, where the brightest public school students are selected out of test taking, the estimated effect of private schooling on test performance is positive. If the worst-performing public school students miss the NAEA tests, then the estimated effect of private schooling on the test score is as large as 0.15 standard deviations for Korean, 0.14 for mathematics, and 0.13 for English. The effect size based on the OLS estimates is roughly half of what Angrist et al. (2002) found for the random assignment of private school vouchers in Colombia. It is not surprising that the estimates are

smaller than those reported in Angrist et al. (2002). Unlike the situation in Colombia, private and public high schools in Seoul must admit similar students, use similar curricula, and charge the same fees, so there are fewer factors that are different by school types to influence outcomes. Nevertheless, the effect is substantial, considering that a one standard deviation increase in teacher quality (i.e., measured by teacher-fixed effects) is found to increase student test scores by 0.1 standard deviations (Rockoff 2004). Private schools in Seoul achieve this effect without increasing average expenditures on teachers per student.

In sum, dropout rates and graduation rates are similar between private and public high schools, but private high schools have fewer student disciplinary problems and are more likely to place their students into higher education institutions. The higher college attendance rates of private school students are primarily driven by four-year college attendance. Private schooling helps boys more than girls in college attendance. Private high schools also improve students' standardized test performance and decrease their likelihood of being absent on the day of NAEA examination. The findings support the hypothesis that giving schools greater autonomy, while incentivizing the principals and teachers, will lead to better student outcomes.

6. CHANNELS OF THE PRIVATE SCHOOL EFFECTS

In this section, we examine several potential channels through which private schools may lead to the positive outcomes documented above. We first focus on examining various factors that reflect the extent of school autonomy in personnel decisions before examining channels not related to autonomy.

6.1. Several Aspects of School Autonomy

Private schools have autonomy over their personnel decisions and this autonomy leads them to have different resource allocations, incentive structures,

and teacher compositions from public schools. We examine whether some of these differences, such as the share of short-term contract teachers, average compensation, wage dispersion, and workforce heterogeneity, are plausible elements that explain the outcome differences across school ownership types.[24] If these elements explain outcome differences, their effects are likely to operate differently across school types, because private schools can directly and intentionally vary these factors to affect student outcomes, while the differences in these factors in public schools are primarily the results of the teacher rotation system implemented by the school district offices over which public schools have no control.

To examine which factors drive the outcome differences across schools, we estimate the effect of private schooling by adding the extra terms $\gamma Z_{jkt} + \rho Private_{jk} \times Z_{jkt}$ to equation (1). We include the interaction term to allow the effect of a factor Z to differ between private and public schools. If a factor Z explains the outcome differences, then we would expect ρ to be positive for four-year college attendance rates and test scores, and negative for two-year college attendance rates and violent incidents per student. The inclusion of Z should also absorb the private school effects, so that the private school coefficient β decreases in magnitude or changes signs compared to specifications excluding these potential drivers of the private school effects. It is important to note that we do not aim to identify the causal effects of Z, as Z is not assigned randomly to schools. The primary purpose of this exercise is to pinpoint the elements of school autonomy that are responsible for the outcome differences.

Table IX reports the results. Panel A shows that the effects of the share of short-term contract teachers on outcomes are zero for both private and public schools, even though the interaction term has a positive sign for four-year college

[24] We thank John A. List for suggesting these factors to be considered as potential explanations.

attendance rates and test scores. Including the share of short-term contract teachers also does not explain away the private school effects. Similarly, panel B shows that the differences in the average teacher and staff compensation do not explain away the private school effects. Note that the average compensation includes both base salary and bonus components. Private schools with higher average compensation actually have poorer outcomes, so average compensation is unlikely to be the driver for the outcome differences.[25] In Panel C, the within-school dispersion of salary absorbs the private school effects.[26] The inclusion of salary dispersion actually reverses the signs of the private school effects. Moreover, as the within-school salary dispersion increases, private school student outcomes improve, while public school student outcomes worsen. Similarly, panel D shows that the within-school dispersion of teacher types (i.e., whether they have an advanced certificate or not) absorbs or reverses the private school effects. [27] The dispersion of teacher types improves student outcomes in private schools and worsens student outcomes in public schools. Thus, the within-school dispersions of teacher salary and types likely explain the outcome differences.

[Table IX]

Why are the effects of within-school dispersions of teacher salary and teacher types on student outcomes opposite for private and public schools? There are several possible explanations. First, private schools can more flexibly promote

[25] Past findings on the effects of higher teacher salaries on student outcomes are mixed. For example, see Loeb and Page (2000) for a discussion.

[26] We have data of teacher salary by school type at the administrative level, rather than at the school level, for all the 25 administrative districts between 2008 and 2010. To check if the results are robust, we re-estimate the main results shown in Tables VI to VIII by first aggregating school-level data by school type up to the administrative level. We obtain similar estimated coefficients and standard errors.

[27] Within-school dispersion of senior teachers (those with an advanced certificate) is calculated using percentage of senior teachers at each school.

a high-performing teacher to a high-paying senior administrative position and a short-term contract teacher to a regular position. Teachers may be incentivized to deliver good student outcomes in such an environment. Second, the larger dispersion in the types of teachers within private schools indicates that they have a more heterogeneous workforce. Since each student's outcomes are the outputs of a team of teachers responsible for different subjects at various grade levels, it is possible that the heterogeneous workforce in private schools generates a mutual learning and collaborative environment, where "high-ability workers pull up the productivity of low-ability workers". In contrast, the variations in within-school dispersions of salary and types of teachers in public schools are mainly driven by the public school teacher rotation system. Public high schools with larger salary dispersion and heterogeneous workforce are likely those that experience larger churning of teachers. The churning of teachers may not only generate greater disruption to students' learning, but may also reduce the incentives for teachers to invest in school-specific human capital, and hence worsen student outcomes.

6.2. Private Tutoring

South Korea has one of the most active private tutoring markets in the world (Bray 2009). Students may vary their use of private tutoring depending on the actual or perceived quality of school (Wang 2015; Hahn and Wang, 2015). On the one hand, it is possible that private tutoring is complementary to private schooling, and thus private schooling may increase the likelihood of students having private tutoring after school. Conversely, students in public schools may not be satisfied with their school quality, and in response increase private tutoring. If private tutoring is more effective for private school students than for public school students, then it is through private tutoring that private school students show better outcomes than public school students.

To test if differential responses in private tutoring result in differential student outcomes across school types, we use students' self-reported frequency of private tutoring available in the 2010 NAEA dataset and estimate the effect of private schooling in the same way as in Section 6.1 by adding the extra terms $\gamma Z_{jkt} + \rho Private_{jk} \times Z_{jkt}$ to equation (1), where Z denotes private tutoring. If private tutoring is an important channel for private schooling to be more effective than public schooling, then we would expect ρ to be positive for four-year college attendance rates and test scores, and negative for two-year college attendance rates and violent incidents per student. The private school coefficient β should also decrease in magnitude or change signs after adding these extra terms.

Table X reports the results. Private tutoring is more effective for public school students than for private school students. Furthermore, including private tutoring and the interaction term makes the effects of private schools on student outcomes larger. Thus, private tutoring is unlikely the channel for the differences in student outcomes between private and public schools.

[Table X]

6.3 History of Private Schools

Private schools were typically established much earlier than public schools in Seoul (panel A, Table IV). It is possible that the longer history of private schools is giving them more experience in operating schools and hence better student outcomes. We follow the same empirical strategy as in the previous two subsections by adding the variable years since establishment and its interaction with the private school indicator when estimating the effects of private schooling. The results reported in Table XI indicate that the private school effects are unlikely to be driven by the longer history of private schools.

[Table XI]

6.4 Religious Private Schooling

Only private schools can be religiously affiliated, and about 28 percent of private schools in Seoul are religious schools, with the majority of them being Christian private schools. Past studies in other countries, such as the U.S. and Australia, have shown some benefits associated with Catholic private schooling for individuals (e.g., Evans and Schwab 1995; Neal 1997; Vella 1999; Altonji et al. 2005a, 2005b). It is possible that religious affiliation of private schools, rather than the ownership type per se, explains the outcome differences across school types in Seoul. When we run regressions for each outcome variable against a religious affiliation dummy for the sample of private schools, the estimates show no differences between religiously affiliated private schools and secular private schools (Table XII).[28] Thus, the religious affiliation of schools plays no role in explaining the results. The lack of difference between religious and secular private schools in our setting does not necessarily mean that religious schooling does not affect student outcomes. Due to the random allocation, the students in Seoul must attend the assigned high schools even when their religions differ from the religious affiliation of the schools. Given past findings on the positive effects of Catholic schooling, the religious match between students and schools might be important.

[Table XII]

6.5 Single-Sex Schooling

[28] The main results are also not sensitive to dropping the sample of religious private schools or adding an indicator for religious private schools.

Private schools in Seoul are more likely to be single-sex. It is possible that the estimated private school effects also capture the effects of single-sex schooling. We include an additional control variable for whether the school is coeducational and estimate the effects of private schooling by gender. If the private school effects are present after controlling for the gender type of a school, then the effects are less likely to be driven by single-sex schooling. The analysis is pertinent, as Park et al. (2013) show that students in single-sex high schools outperform those in coeducational high schools in some academic outcomes.

Similar to the results reported earlier, Table XIII shows that private schooling reduces the likelihood of violent incidents and increases the probability of attending college after controlling for the gender type of a school. The estimated effects of private schooling on test scores become smaller and also a bit noisier.[29] Overall, students attending private schools still show higher test scores than students attending public schools for both genders. Thus, the effects of private schooling on college outcomes and violent incidents are unlikely to be driven by single-sex schooling, but the tendency for private schools to be single-sex may partially contribute to their higher average test scores.

[Table XIII]

7 CONCLUSIONS

In this paper, we exploit the random assignment of students into private and public high schools within school districts in Seoul under the high school equalization policy to show that private schools, which have greater autonomy but

[29] We report a more stringent test to assess the effects of single-sex schooling in an appendix (Table A5) where we split the sample by gender type of school. The results also show that private school students have better outcomes than public school students, but the private school effects on test scores are noisy in coeducational schools, as the sample of coeducational schools is quite small.

their principals and teachers face stronger incentives to perform, deliver better student outcomes. Because of the equalization policy and the randomization of students into schools, we are able to rule out many factors that are commonly attributed to the effects of private schooling, such as peer quality, resources, curricula differences, and incentives for schools to compete for students and revenues. Our results show that private schooling leads to a greater likelihood of four-year college attendance, lower likelihood of two-year college attendance, and fewer violent incidents per student. Private schooling has, however, no significant effect on dropout rates and high school seniors' graduation rates. Private school students are more likely to be present on the day of national standardized tests. Private school students outperform public school students in Korean, English, and mathematics standardized tests, even after taking into account the potential non-random selection into test taking.

We rule out longer history of private schools, single-sex schooling, religious affiliation of private schools, and the greater use of private tutoring as potential channels of the private school effects. Our estimated effects of private schooling reflect that autonomy in personnel decisions, together with strong incentives for principals and teachers to perform, may be effective in creating positive student outcomes. In particular, as teacher heterogeneity and salary dispersion increase within schools, student outcomes improve in private schools, but worsen in public schools. The positive effects of the within-school variation in salary and types of teachers on student outcomes in private schools are consistent with the benefits of private schools having autonomy in personnel decisions. The results for public schools are consistent with the disruptive effects on students' learning due to teacher churning under the teacher rotation system.

Several caveats apply when drawing policy implications from this study. The randomized natural experiment in Seoul mainly provides a unique opportunity for us to learn about the benefits of giving greater autonomy to

schools, while ensuring that principals and teachers face strong incentives to perform, on student outcomes. As a key argument for why private and other forms of independent schooling may improve outcomes lies in their potential to increase competition, our findings do not imply that policymakers should also adopt a policy that randomizes students across schools and eliminates the incentives for schools to compete for students. We do not rule out factors such as job security and incentive structures as the other channels through which private schools deliver better student outcomes in Seoul. Nonetheless, in the absence of school autonomy, it would not have been possible for any of these channels to work in the first place. Finally, the findings in Korea may have implications for countries with similar institution and economic development, but may not be extended to other economies, as Hanushek et al. (2013) argue that the effect of school autonomy depends on the context under which the school operates. More evidence is needed to improve our understanding of how giving schools autonomy may lead to better student outcomes.

REFERENCES

Abdukadiroglu, Atila, Joshua D. Angrist, Susan M. Dynarski, Thomas J. Kane, and Parag A. Pathak. 2011. "Accountability and Flexibility in Public Schools: Evidence from Boston's Charters and Pilots." *Quarterly Journal of Economics*, vol.126: 699-748.

Alexander, Karl L., and Aaron M. Pallas. 1983. "Private Schools and Public Policy: New Evidence on Cognitive Achievement in Public and Private Schools." *Sociology of Education*, vol.56: 170-81.

Altonji, Joseph G., Todd E. Elder, and Christopher R. Taber. 2005a. "An Evaluation of Instrumental Variable Strategies for Estimating the Effects of Catholic Schools." *Journal of Human Resources*, vol.40: 791-821.

Altonji, Joseph G., Todd E. Elder, and Christopher R. Taber. 2005b. "Selection on Observed and Unobserved Variables: Assessing the Effectiveness of Catholic Schools." *Journal of Political Economy*, vol.113: 151-184.

Angrist, Joshua, Eric Bettinger, Erik Bloom, Elizabeth King, and Michael Kremer. 2002. "Vouchers for Private Schooling in Colombia: Evidence

from a Randomized Natural Experiment." *American Economic Review*, vol.92(5): 1535-1558.

Angrist, Joshua, Eric Bettinger, and Michael Kremer. 2006. "Long-Term Educational Consequences of Secondary School Vouchers: Evidence from Administrative Records in Colombia." *American Economic Review*, vol.96(3): 847-862.

Branham, David. 2004. "The Wise Man Builds His House Upon the Rock: The Effects of Inadequate School Building Infrastructure on Student Attendance." *Social Science Quarterly*, vol.85(5): 1112-1128.

Bray, Mark. 2009. *Confronting the Shadow Education System: What Government Policies for What Private Tutoring?* International Institute for Educational Planning, Paris.

Clark, Damon. 2009. "The Performance and Competitive Effects of School Autonomy." *Journal of Political Economy*, 117(4): 745-783.

Coleman, James, Thomas Hoffer, and Sally Kilgore. 1982. *High School Achievement: Public, Catholic and Private Schools Compared*. Basic Books, NY.

Coleman, James, and Thomas Hoffer. 1987. *Public and Private Schools: The Impacts of Communities*. New York: Basic Books.

Cullen, Julie Berry, Brian A. Jacob and Steven Levitt. 2006. "The Effect of School Choice on Participants: Evidence from Randomized Lotteries." *Econometrica*, vol.74(5): 1191-1230.

Dobbie, Will and Roland G. Fryer, Jr. 2013. "Getting Beneath the Veil of Effective Schools: Evidence from New York City." *American Economic Journal: Applied Economics* vol.5(4): 28-60.

Duflo, Esther, Pascaline Dupas and Michael Kremer. 2011. "Peer Effects and the Impacts of Tracking: Evidence from a Randomized Evaluation in Kenya", *American Economic Review*, 101(5):1739-74.

Evans, William, and Robert Schwab. 1995. "Finishing High School and Starting College: Do Catholic Schools Make a Difference?" *Quarterly Journal of Economics*, vol.110: 947-974.

Figlio, David, and Joe A. Stone. 1999. "School Choice and Student Performance: Are Private Schools Really Better?" *Research in Labor Economics*, vol.18: 115-140.

Glewwe, Paul W., Eric A. Hanushek, Sarah D. Humpage and Renato Ravina. 2011. "School Resources and Educational Outcomes in Developing Countries: A Review of the Literature from 1990 to 2010," NBER Working Paper 17554, October.

Hahn, Youjin, and Liang Choon Wang. 2015. "Out-of-School Activities and Effectiveness of Single-Sex and Private Schools." Available at SSRN: http://dx.doi.org/10.2139/ssrn.2607313.

Hamilton, Barton H., Jack A. Nickerson, and Hideo Owan. 2003. "Team Incentives and Worker Heterogeneity: An Empirical Analysis of the Impacts of Teams on Productivity and Participation." *Journal of Political Economy*, vol.111(3): 465-497.

Hanushek, Eric A. 2006. "School Resources." *Handbook of the Economics of Education, 2*, 865-908.

Hanushek, Eric. A., and Steven G. Rivkin. 2006. "Teacher quality." *Handbook of the Economics of Education, 2*, 1051-1078.

Hanushek, Eric A., Susanne Link, and Ludger Woessmann. 2013. "Does School Autonomy Make Sense Everywhere? Panel Estimates from PISA." *Journal of Development Economics*, vol.104, 212-232.

Hoxby, Caroline M., and Sonali Murarka. 2009. Charter schools in New York City: Who enrolls and how they affect their students' achievement. *NBER Working Paper* 14852.

Kang, Changhui. 2007 "Classroom Peer Effects and Academic Achievement: Quasi-randomization Evidence from South Korea." *Journal of Urban Economics*, vol.61: 458–495.

Kim, E. G., Kim, K. S., Kim, D. K., and Kim, E. Y. 2007. *Improving School Leadership: Country Background Report for Korea*.

Krueger, Alan B., and Pei Zhu, 2004. "Another look at the New York City school voucher experiment." *American Behavioral Scientist*, vol.47(5): 658–698.

Lee, David S. 2009. "Training, Wages, and Sample Selection: Estimating Sharp Bounds on Treatment Effects." *Review of Economic Studies*, vol.6(3): 1071-1102

Loeb, Susanna, and Marianne E. Page. 2000. "Examining the Link between Teacher Wages and Student Outcomes: The Importance of Alternative Labor Market Opportunities and Non-Pecuniary Variation." *Review of Economics and Statistics*, vol.82(3): 393-408.

Muralidharan, Karthik and Venkatesh Sundararaman. 2013. Contract Teachers: Experimental Evidence from India. NBER Working Paper No. 19440

Neal, Derek. 1997. "The Effect of Catholic Secondary Schooling on Educational Attainment." *Journal of Labor Economics*, vol.15: 98-123.

Peterson, Paul E., William G. Howell, Patrick J. Wolf, and David E. Campbell. 2003. "School Vouchers: Results from Randomized Experiments." C. Hoxby (Ed.), *The Economics of School Choice*, University of Chicago Press, Chicago.

Paik, Sung Joon. 2013. 2012 *Modularization of Korea's Development Experience: Role of Private Schools in Korea's Educational Development*, KDI School of Public Policy and Management, Korea.

Park, Hyunjoon, Jere R. Behrman, and Jaesung Choi. 2013. "Causal Effects of Single-Sex Schools on College Entrance Exams and College Attendance:

Random Assignment in Seoul High Schools." *Demography*, vol. 50(2): 447-469.

Rockoff, Jonah. 2004. "The Impact of Individual Teachers on Student Achievement: Evidence from Panel Data," *American Economic Review, Papers and Proceedings*, vol.94: 247-252

Vanderberghe, Vincent, and Stephane R. Robin. 2004. "Evaluating the Effectiveness of Private Education Across Countries: A Comparison of Methods." *Labour Economics*, vol.11: 487-506.

Vella, Francis. 1999. "Do Catholic Schools Make a Difference? Evidence from Australia." *Journal of Human Resources*, vol.34: 208-224.

Wang, Liang Choon. 2015. "All Work and No Play? The Effects of Ability Sorting on Students' Non-school Inputs, Time Use, and Grade Anxiety," *Economics of Education Review*, vol.44: 29-41.

Table I

Distribution of School Types by School District in 2008

School district	Number of schools	Private schools			Public schools		
		Coed.	All-boys	All-girls	Coed.	All-boys	All-girls
1	25	3	6	6	7	2	1
2	25	4	9	6	5	0	1
3	19	4	3	4	5	1	2
4	11	1	4	3	1	1	1
5	17	3	8	5	0	0	1
6	18	0	3	2	10	1	2
7	16	2	4	3	5	1	1
8	9	1	1	2	4	0	1
9	13	0	4	4	4	1	0
10	24	3	5	6	9	1	0
11	21	0	8	9	1	3	0
Total	198	21	55	50	51	11	10

Notes: There were 208 equalization policy high schools in Seoul in 2008. 10 of them are excluded from our sample because they do not have grade 12 students' outcomes available throughout 2008 and 2010 or they changed their academic types in 2010. Distribution of religious school types by school district is reported in Table A1 in the appendix.

Table II

Summary Statistics of Variables by Private and Public Schools

		Private		Public		Difference	
	Obs.	Mean	S.D.	Mean	S.D.	Mean	
A. School-level student characteristics							
Share of students on welfare assistance	198	0.041	0.044	0.040	0.026	0.001	
Share of minority students	198	0.001	0.002	0.001	0.001	0.000	
Share of students on lunch support	594	0.107	0.135	0.098	0.112	0.009	
Net transfer rate	594	0.001	0.012	0.002	0.011	-0.001	
B. Individual-level student characteristics							
Single-mother household – Male	48566	0.075	0.264	0.074	0.262	0.001	
Dual-parent household – Male	48566	0.877	0.328	0.872	0.334	0.005	
Single-mother household – Female	41259	0.082	0.274	0.082	0.274	0.000	
Dual-parent household – Female	41259	0.876	0.330	0.874	0.332	0.002	
C. School-level student outcomes							
Dropout rate	594	0.018	0.024	0.017	0.007	0.001	
Seniors' graduation rate	594	0.977	0.080	0.976	0.038	0.001	
College attendance rate	594	0.598	0.081	0.565	0.078	0.033	***
Four-year college attendance rate	594	0.406	0.065	0.345	0.062	0.061	***
Two-year college attendance rate	594	0.192	0.080	0.220	0.088	-0.028	**
Violent incidents per 1000 students	594	0.0015	0.001	0.0006	0.002	-0.001	***
D. Individual-level student outcomes							
NAEA – Korean standardized test score	89825	0.051	0.966	-0.095	1.016	0.146	***
NAEA – Math standardized test score	89825	0.048	0.987	-0.090	0.981	0.138	***
NAEA – English standardized test score	89825	0.050	0.973	-0.094	1.007	0.144	***

Notes: In panel A, school-level share of students on welfare assistance and share of ethnic minority students came from NAEA 2010 principal survey, whereas school-level share of students on lunch support and net transfer rate for 2008-2010 came from the Ministry of Education, Technology and Science's (METS) website: www.schoolinfo.go.kr. In panel B, individual students' household information came from the NAEA 2010 grade-11 student survey. In panel C, school-level student outcomes for 2008-2010 came from METS's website. In panel D, individual students' standardized test scores came from NAEA 2010 grade-11 students' test score dataset and we standardized test scores to have mean 0 and standard deviation 1. Mean difference is tested by regressing each variable on a dummy of private school and standard errors are clustered at the school level. *** p<0.01, ** p<0.05, * p<0.1.

Table III

Verification of Random Assignment

	(1)	*(2)*	*(3)*	*(4)*
A. School-level student characteristics	% students on welfare assistance	% ethnic minority students	% students on lunch support	Net transfer rate
Private	-0.002	0.0000	0.014	-0.0002
	(0.004)	(0.0002)	(0.011)	(0.001)
R-squared	0.136	0.104	0.149	0.231
District-year F.Es	Yes	Yes	Yes	Yes
Sample year	2010	2010	2008-2010	2008-2010
Number of schools	198	198	198	198
Number of coed schools	72	72	72	72
Number of all-boys schools	66	66	66	66
Number of all-girls schools	60	60	60	60
Grade level	10-12	10-12	10-12	10-12
Mean of dependent variable (public)	0.039	0.001	0.094	0.002
B. Individual-level student characteristics	Single-mom: Male	Dual-parent: Male	Single-mom: Female	Dual-parent: Female
Private	0.000	0.007	-0.002	0.005
	(0.004)	(0.005)	(0.004)	(0.005)
R-squared	0.001	0.001	0.001	0.002
District-year F.Es	Yes	Yes	Yes	Yes
Sample year	2010	2010	2010	2010
Number of students	48566	48566	41259	41259
Number of schools	138	138	132	132
Number of coed schools	72	72	72	72
Number of all-boys schools	66	66	0	0
Number of all-girls schools	0	0	60	60
Grade level	11	11	11	11
Mean of dependent variable (public)	0.074	0.872	0.082	0.874
Relationship with individual student's				
Average NAEA standardized test score	-0.289	0.364	-0.287	0.352
	(0.017)***	(0.016)***	(0.017)***	(0.016)***

Notes: In panel A, data in columns (1) and (2) came from NAEA 2010 principal survey and data in columns (3) and (4) came from www.schoolinfo.go.kr. Regressions in panel A are weighted by the number of students enrolled in the school in each year. In panel B, data came from NAEA 2010 student survey. Robust standard errors clustered by school are reported in parentheses. The estimated relationship between average NAEA standardized test scores (average across Korean, math and English) and each student characteristics is based on a specification that includes each student characteristics, a private school indicator and district-year fixed effects on the right hand side. Additional tests for randomization are reported in Table A3. *** p<0.01, ** p<0.05, * p<0.1

Table IV

School Characteristics and Principals' Value on Student Outcomes

		Private		Public		Difference	
	Obs.	Mean	S.D.	Mean	S.D.	Mean	
A. School characteristics							
Teacher and staff salary per stud. ('000KRW)[#]	197	3188	389.5	3250	246.0	-61.6	
Student teacher ratio	594	18.33	1.45	17.77	1.28	0.562	***
Teachers with a M.A degree^	198	0.330	0.130	0.472	0.120	-0.142	***
Teachers with an adv. cert. (proxy for exp.)	594	0.741	0.099	0.846	0.064	-0.105	***
Teachers on short-term contracts	594	0.107	0.059	0.046	0.031	0.061	***
School passed infrastructure inspection	594	0.931	0.253	0.912	0.284	0.019	
Average teacher and staff compensation ('000KRW)[#]	197	50881	4687	49277	3772	1604	***
Within-school base salary dispersion (SD.)	594	8.10	0.404	7.49	0.418	0.61	***
Within-school teacher type (adv. cert) dispersion (SD.)	594	0.425	0.065	0.351	0.064	0.073	***
Years since establishment	594	30.83	14.27	19.50	11.63	11.33	***
Tracking – Korean^	198	0.175	0.381	0.097	0.298	0.077	
Tracking – Mathematics^	198	0.968	0.176	0.986	0.118	-0.018	
Tracking – English^	198	0.960	0.196	0.972	0.165	-0.012	
Tracking – Science^	198	0.032	0.176	0.014	0.118	0.018	
Tracking – Social studies^	198	0.016	0.125	0.028	0.165	-0.012	
B. Perception of principals							
Good academic performance is important	122	0.319	0.469	0.367	0.487	-0.049	
Entering into prestigious university is important	122	0.710	0.457	0.408	0.497	0.302	***
Good disciplines and behaviors is important	122	0.855	0.355	0.898	0.306	-0.043	
Creativity development is important	122	0.087	0.284	0.306	0.466	-0.219	***
Excel in extracurricular activities is important	122	0.000	0.000	0.020	0.143	-0.020	

Notes: School characteristics in panel A are drawn from www.schoolinfo.go.kr for the years 2008, 2009, and 2010, except that variables about teacher compensation ([#]) are only available for 197 schools in 2009 and variables about teachers with a M.A. degree and whether the school uses tracking (^) are drawn from the NAEA 2010 principal survey. Within-school base salary dispersion is constructed using administrative district level information on the number of teachers in various pay grades and the corresponding base salary for each grade by school type. Data of the number of teachers by pay grade and type of school came from http://statistics.sen.go.kr and data of base salary by pay scale came from http://www.mospa.go.kr. Because the base salary data are aggregated at the administrative district level, the sample includes a few schools did not have data available consistently throughout 2008 to 2010. The within-school teacher type dispersion is the standard deviation of the dummy variable indicating whether a teacher has an advanced certificate in a school. The statistics reported in panel B are based on the high school principal survey that the authors conducted in 2013. Only 122 principals responded to the survey. There is no differential response rate between private and public school principals. Each principal in the survey is asked to pick two most important outcomes out of five measures of student achievement indicated in the table. A variable in panel B takes the value of one when a principal picked a particular outcome as one of the two most important measures. Mean difference is tested by regressing each variable on a dummy of private school and standard errors are clustered at the school level. *** $p<0.01$, ** $p<0.05$, * $p<0.1$

Table V

Principals' Perception on Differences between Private and Public schools

1. More flexible and autonomous school policies	%
Public schools are more flexible	5.98
Private schools are more flexible	70.09
Equally flexible	23.93
2. Principal job security	
Public schools are more secure than private schools	62.71
Private schools are more secure than public schools	5.08
Equal job security	32.2
3. Teacher job security	
Public schools are more secure than private schools	39.83
Private schools are more secure than public schools	5.08
Equal job security	55.08
4. Principals' incentives to deliver good student outcomes (test score and college attendance)	
Public schools have greater incentives than private schools	7.63
Private schools have greater incentives than public schools	76.27
Equal incentives	16.1
5. Teachers' incentives to deliver good student outcomes (test score and college attendance)	
Public schools have greater incentives than private schools	8.55
Private schools have greater incentives than public schools	76.92
Equal incentives	14.53
6. The punishment for teachers for poor performance	
Public schools have greater punishments	15.38
Private schools have greater punishments	47.01
Equal punishments	37.61
7. Whether teachers are encouraged to implement innovative classroom practices and solutions	
Public schools have more encouragement	14.66
Private schools have more encouragement	63.79
Equal encouragement	21.55

Notes: The results are based on the high school principal survey we conducted in 2013. We surveyed 173 principals in 2013, because 25 of the 198 schools changed their school type to autonomous schools after 2010. Out of the 173 principals that we surveyed, 122 responded. There is no differential response rate between private and public school principals.

Table VI
The Effects of Private Schooling on School-level Students' Outcomes

	(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*
	Percent dropout	Percent graduation	Violence per capita	Percent College	Percent Four-year	Percent Two-year
Private	-0.001	0.002	-0.001	0.044	0.063	-0.019
	(0.001)	(0.005)	(0.000)***	(0.008)***	(0.007)***	(0.009)**
R-squared	0.041	0.066	0.146	0.397	0.392	0.454
District-year F.Es	Yes	Yes	Yes	Yes	Yes	Yes
Number of schools	198	198	198	198	198	198
Sample year	2008-2010	2008-2010	2008-2010	2008-2010	2008-2010	2008-2010
Grade level	10-12	12	10-12	12	12	12
Mean of dependent variable (public)	0.017	0.976	0.001	0.562	0.347	0.215

Notes: All regressions are weighted by the total number of students in the denominators. Percent dropout is the number of dropouts over total numbers of beginning-of-year enrollment; percent graduation is the share of seniors (grade 12) graduating from high school; violence per capita is the number of reported violent incidents per student; Percent college is the number of graduates entering into any foreign or domestic university or college over total number of seniors; Percent four-year (two-year) is the number of graduates entering into any foreign or domestic four-year (two-year) university or college over the total number of seniors. The sample includes 11 school districts. Robust standard errors clustered by school are reported in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table VII
The Effects of Private Schooling on College Attendance Outcomes by Gender

	(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*
	Percent College: Male	Percent Four-year: Male	Percent Two-year: Male	Percent College: Female	Percent Four-year: Female	Percent Two-year: Female
Private	0.051	0.072	-0.021	0.022	0.049	-0.027
	(0.010)***	(0.008)***	(0.009)**	(0.008)***	(0.010)***	(0.012)**
R-squared	0.473	0.431	0.495	0.436	0.365	0.481
District-year F.Es	Yes	Yes	Yes	Yes	Yes	Yes
Number of schools	138	138	138	132	132	132
Number of coed schools	72	72	72	72	72	72
Number of all-boys schools	66	66	66	0	0	0
Number of all-girls schools	0	0	0	60	60	60
Sample year	2008-2010	2008-2010	2008-2010	2008-2010	2008-2010	2008-2010
Mean of dependent variable (public)	0.528	0.335	0.192	0.616	0.367	0.249

Notes: All regressions are weighted by the total number of students in the denominators. The sample includes 11 school districts. Robust standard errors clustered by school are reported in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table VIII

Differences in Taking Rates and Test Scores between Private and Public School Students

	(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*
	Korean Missing	Math Missing	English Missing	NAEA Korean	NAEA Math	NAEA English
Private	-0.017	-0.017	-0.017	0.125	0.116	0.116
	(0.003)***	(0.003)***	(0.003)***	(0.039)***	(0.030)***	(0.039)***
R-squared	0.003	0.003	0.003	0.024	0.042	0.066
District F.Es	Yes	Yes	Yes	Yes	Yes	Yes
Observations	89825	89825	89825	89825	89825	89825
Mean of dep. var.	0.037	0.037	0.036	-0.095	-0.090	-0.094
Sharp Bounds:						
Lower-bound				0.072	0.069	0.083
				(0.044)*	(0.030)**	(0.043)**
Upper-bound				0.151	0.140	0.126
				(0.048)***	(0.035)***	(0.047)***
Trim. proportion				0.016	0.016	0.015

Notes: Each of the first three dependent variables measures whether the student is absent on the day of the particular test. The last three dependent variables are the NAEA test scores normalized to have mean zero and variance one. OLS estimates in columns 4 to 6 in the top panel include missing values replaced with the average test score by school type within each district. Mean of dependent variable is for public schools. The sample includes 11 school districts for the year 2010. Lower- and upper-bound effects are estimated using Lee's (2009) sharp-bound estimators. Robust standard errors clustered by school are reported in parentheses in the upper panel. Bootstrapped standard errors (5000 repetitions) clustered by school are reported in parentheses for the sharp-bound estimates in the bottom panel. *** p<0.01, ** p<0.05, * p<0.1

Table IX
Potential Aspects of School Autonomy Explaining the Private School Effects

	(1) Violence per capita	(2) % 4-year College	(3) % 2-year College	(4) NAEA Korean	(5) NAEA Math	(6) NAEA English
A. Short-term contract teachers						
Private	-0.001	0.054	-0.008	0.049	0.047	0.028
	(0.000)***	(0.014)***	(0.017)	(0.071)	(0.057)	(0.073)
% Short-term teachers	-0.002	-0.049	0.172	-0.326	-0.500	0.053
	(0.003)	(0.129)	(0.161)	(0.805)	(0.741)	(0.910)
Private × % Short-term teachers	0.001	0.123	-0.212	0.920	0.961	0.797
	(0.004)	(0.160)	(0.193)	(0.913)	(0.821)	(1.019)
R-squared	0.142	0.388	0.437	0.025	0.043	0.067
B. Average salary						
Private	-0.007	0.293	-0.315	1.421	0.895	1.668
	(0.003)**	(0.126)**	(0.118)***	(0.427)***	(0.366)**	(0.455)***
Average salary	-0.000	0.002	-0.005	0.005	0.011	0.012
	(0.000)*	(0.002)	(0.002)**	(0.007)	(0.006)*	(0.008)
Private × Average salary	0.000	-0.004	0.006	-0.026	-0.016	-0.031
	(0.000)*	(0.003)*	(0.002)**	(0.009)***	(0.007)**	(0.009)***
R-squared	0.187	0.325	0.432	0.030	0.042	0.069
C. Base salary dispersion						
Private	0.013	-0.255	0.448	-1.419	-1.767	-2.471
	(0.005)***	(0.142)*	(0.194)**	(1.000)	(0.703)**	(0.986)**
SD(Base salary)	0.002	-0.024	0.048	-0.187	-0.206	-0.278
	(0.001)***	(0.011)**	(0.017)***	(0.076)**	(0.058)***	(0.077)***
Private × SD(Base salary)	-0.002	0.041	-0.062	0.201	0.244	0.335
	(0.001)***	(0.018)**	(0.025)**	(0.125)	(0.088)***	(0.124)***
R-squared	0.191	0.394	0.451	0.026	0.044	0.069
D. Teacher type dispersion						
Private	0.002	-0.030	0.086	-0.532	-0.270	-0.653
	(0.001)**	(0.061)	(0.073)	(0.258)**	(0.225)	(0.294)**
SD(Senior teachers)	0.007	-0.101	0.187	-0.527	-0.824	-0.995
	(0.003)***	(0.068)	(0.095)*	(0.340)	(0.379)**	(0.488)**
Private × SD(Senior teachers)	-0.009	0.241	-0.284	1.646	1.049	1.987
	(0.003)***	(0.147)	(0.178)	(0.634)**	(0.570)*	(0.745)***
R-squared	0.175	0.398	0.445	0.028	0.043	0.069

Notes: Specifications in columns 1 to 3 include 594 observations each (198 schools over 3 years), except those in Panel B, where 197 observations are included because only one year of salary data are available. Similarly, specifications in columns 4 to 6 include 89825 observations each, except those in Panel B, where 89394 observations are included. All specifications include a set of district-year fixed effects. Base salary dispersion data are not school level data, but administrative district level data by school type. All results reported in other tables are not sensitive to aggregation at the administrative district level by school type. Robust standard errors clustered by school are reported in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table X

Private Tutoring as a Channel of Private School Effects

	(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*
	Violence per capita	Four-year college	Two-year college	NAEA-Korean	NAEA-Math	NAEA-English
Private	-0.004	0.240	-0.150	0.211	0.180	0.185
	(0.001)***	(0.052)***	(0.045)***	(0.052)***	(0.032)***	(0.043)***
Private tutoring	-0.001	0.087	-0.176	0.149	0.206	0.199
	(0.000)***	(0.015)***	(0.015)***	(0.007)***	(0.007)***	(0.007)***
Priv.×Priv. tutoring	0.001	-0.059	0.042	-0.027	-0.020	-0.021
	(0.000)**	(0.018)***	(0.015)***	(0.009)***	(0.009)**	(0.010)**
R-squared	0.170	0.445	0.673	0.066	0.131	0.148
District-year F.Es	Yes	Yes	Yes	Yes	Yes	Yes
Sample year	2008-2010	2008-2010	2008-2010	2010	2010	2010
Mean of dep. var.	0.001	0.409	0.180	0.063	0.078	0.086

Notes: Estimates in columns 1-3 are based on school-level regressions, while estimates in columns 4-6 are based on individual-level regressions. Specifications in columns 1 to 3 include 594 observations each (198 schools over 3 years) and specifications in columns 4-6 include 89825 observations each. Because data on private tutoring are drawn from the NAEA 2010 student survey, we can only link them to test score data (columns 4-6). For columns 1-3, we calculate the average value of private tutoring of grade-11 students for each school and use it as a proxy for private tutoring of all students attending that school. Private tutoring reported in NAEA 2010 is a categorical variable that takes a value from 1 to 5 in increasing order, where 1 means no private tutoring and 5 means more than 3 hours per week. The results are not sensitive if we use dummy variables transformed from the original categorical variable. Robust standard errors clustered by school are reported in parentheses. *** $p<0.01$, ** $p<0.05$, * $p<0.1$

Table XI

History of School as a Channel for Private School Effects

	(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*
	Violence per capita	Four-year college	Two-year college	NAEA-Korean	NAEA-Math	NAEA-English
Private	-0.001	0.069	-0.050	0.212	0.253	0.282
	(0.000)*	(0.013)***	(0.017)***	(0.082)**	(0.065)***	(0.087)***
Yrs. since establishment	0.000	0.000	-0.001	0.004	0.005	0.005
	(0.000)	(0.000)	(0.001)	(0.002)	(0.002)***	(0.002)**
Priv.×Yrs. since estab.	-0.000	-0.000	0.001	-0.004	-0.006	-0.007
	(0.000)	(0.000)	(0.001)*	(0.003)	(0.002)**	(0.003)**
R-squared	0.148	0.393	0.461	0.025	0.044	0.067
District-year F.Es	Yes	Yes	Yes	Yes	Yes	Yes
Sample year	2008-10	2008-10	2008-10	2010	2010	2010
Mean of dep. var.	0.001	0.409	0.180	0.063	0.078	0.086

Notes: Estimates in columns 1-3 are based on school-level regressions, while estimates in columns 4-6 are based on individual-level regressions. Specifications in columns 1 to 3 include 594 observations each (198 schools over 3 years) and specifications in columns 4-6 include 89825 observations each. Robust standard errors clustered by school are reported in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table XII

The Effects of Religious Private Schooling on Student Outcomes

	(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*
	Violence per capita	Four-year college	Two-year college	NAEA-Korean	NAEA-Math	NAEA-English
Religious	-0.0002	-0.009	-0.005	0.021	0.005	0.009
	(0.0002)	(0.009)	(0.014)	(0.060)	(0.042)	(0.052)
R-squared	0.101	0.238	0.430	0.019	0.036	0.060
District-year F.Es	Yes	Yes	Yes	Yes	Yes	Yes
Sample year	2008-2010	2008-2010	2008-2010	2010	2010	2010
Mean of dep. var.	0.001	0.409	0.180	0.063	0.078	0.086

Notes: We restrict the sample to 126 private schools only. 57915 grade-10 private school students are in the NAEA 2010 sample. The indicator 'religious' takes the value of one if the private school is religiously affiliated and zero if it is secular. Roughly 30 percent of the private schools are religiously affiliated and 90 percent of these religious private schools are Christian. Mean of dependent variable is for non-religious private schools. The results presented in Tables VI, VII, and VIII are similar if we drop religious private schools from the sample. Robust standard errors clustered by school are reported in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table XIII

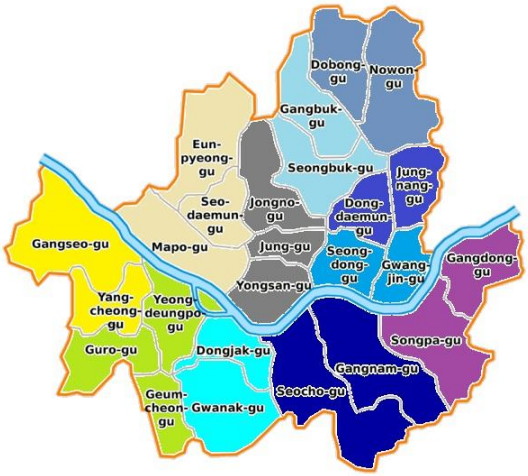
The Effects of Private Schooling on Student Outcomes Controlling for Gender Type of School

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
		---------- Male ----------				---------- Female ----------			
	Violence per capita	Percent College	NAEA Korean	NAEA Math	NAEA English	Percent College	NAEA Korean	NAEA Math	NAEA English
Private	-0.001	0.059	0.101	0.083	0.085	0.037	0.111	0.105	0.100
	(0.0002)***	(0.012)***	(0.049)**	(0.045)*	(0.056)	(0.009)***	(0.043)**	(0.042)**	(0.057)*
Coeducational	0.0003	0.017	-0.078	-0.109	-0.106	0.029	-0.007	-0.004	0.004
	(0.0002)	(0.012)	(0.047)*	(0.044)**	(0.054)*	(0.009)***	(0.041)	(0.043)	(0.057)
R-squared	0.154	0.479	0.032	0.056	0.077	0.465	0.020	0.032	0.059
District-year F.Es	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Number of schools	198	138	138	138	138	132	132	132	132
No. coed schools	72	72	72	72	72	72	72	72	72
No. all-boys schools	66	66	66	66	66	0	0	0	0
No. all-girls schools	60	0	0	0	0	60	60	60	60
Sample year	2008-2010	2008-2010	2010	2010	2010	2008-2010	2010	2010	2010
Mean of dep. var.	0.001	0.517	-0.267	-0.004	-0.171	0.598	0.169	-0.125	0.057

Notes: School-level regressions (columns 1, 2, 6, and 7) are weighted by the numbers of students used in the denominators of the dependent variables. In total, there are 48566 male grade-11 students and 41259 female grade-11 students in the NAEA 2010 sample. We omit results using the percentage of seniors graduated or the percentage of high school dropout as the dependent variable because private and public schools do not differ in these outcomes. Missing test scores are replaced with the mean test scores of the respective gender in private or public high schools within the school district. We do not split violence per capita by gender because the data were not reported by gender at www.schoolinfo.go.kr. Mean of dependent variable is for the public single-sex school sample. Robust standard errors clustered by school are reported in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Figure I

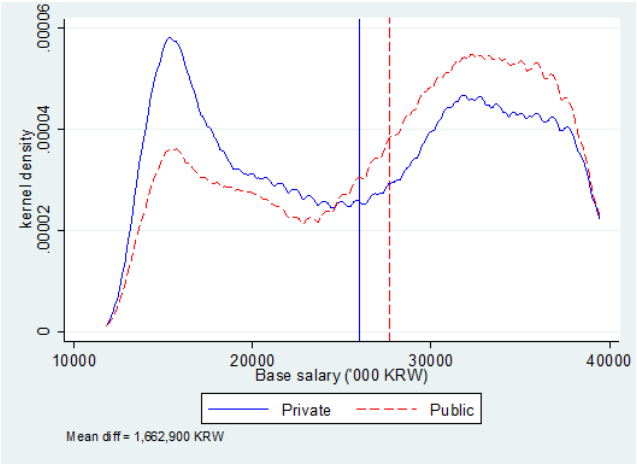
School Districts and Administrative Districts in Seoul



Notes: Seoul has 25 administrative districts. The map shows the 11 official school districts (in colors).
Source: http://commons.wikimedia.org/wiki/File:Map_Seoul_districts_de.png.

Figure II

Distribution of Base Salary by School Type

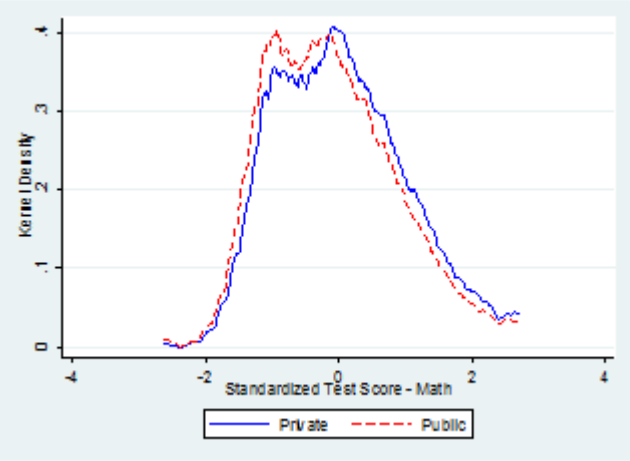


Notes: Kernel density of annual base salary by school type in 2009. We restrict to 2009 sample to allow comparison to average total salary of teachers and staff in 2009. Results are similar when 2008 and 2010 data are included. The vertical lines are the respective means for private (26 million KRW) and public (27.7 million KRW) schools. The standard deviation of base salary for private schools (8.2 million KRW) is larger than that for public schools (7.6 million KRW) by 0.6 million KRW. Kolmogorov-Smirnov test for equality of distribution functions rejects the null hypothesis that the two distributions are similar. Data of the number of teachers by pay grade and type of school were sourced from http://statistics.sen.go.kr and data of base salary by pay scale were sourced from http://www.mospa.go.kr. Because the original data are aggregated at the administrative district level, the sample includes a few schools did not have data available consistently throughout 2008 to 2010.

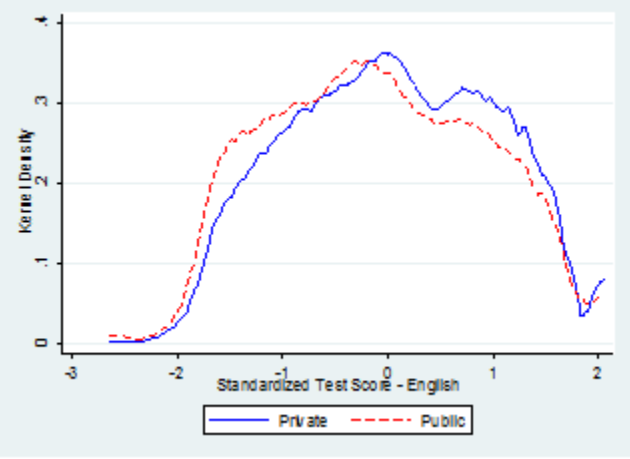
Figure III

Distributions of NAEA Test Scores

Note: Kernel density of NAEA Korean test scores. Test scores are standardized to mean of zero and standard deviation of one.



Note: Kernel density of NAEA mathematics test scores. Test scores are standardized to mean of zero and standard deviation of one.



Note: Kernel density of NAEA English test scores. Test scores are standardized to mean of zero and standard deviation of one.

Appendix: For Online Publication

Table A1: Robustness Checks

	(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*
	Violence per capita	Percent College	Percent Four-year	Percent Two-year	NAEA Korean	NAEA Math	NAEA English
Private	-0.0009	3.784	6.856	-3.072	0.128	0.129	0.129
	(0.0002)***	(0.740)***	(0.858)***	(0.986)***	(0.042)***	(0.031)***	(0.042)***
No. of obs.	519	519	519	519	78312	78361	78376
Sample years	2008-2010	2008-2010	2008-2010	2008-2010	2010	2010	2010
R-squared	0.143	0.388	0.387	0.421	0.025	0.045	0.070

Notes: The table above examines if the main results are sensitive to dropping the school district that practices conditional randomization based on student stated school preferences. All specifications exclude observations (from 25 schools) in the school district that contains Jongno-Gu, Jung-Gu, and Yongsan-Gu, and include district year fixed effects. The sample used in columns 1 to 4 came from www.schoolinfo.go.kr. The sample used in columns 5 to 7 came from NAEA 2010 eleventh graders. % College is the percentage of graduates that attended any college; % 4-year is the percentage of graduates that attended four-year universities; % 2-year is the percentage of graduates that attended two-year colleges. NAEA test scores are standardized to mean zero and standard deviation one and missing scores are replaced with the mean score of school type in the respective school district. Robust standard errors clustered by school are reported in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table A2: Distribution of Religious and Secular Schools by District

School District	Number of Schools	Private Secular	Private Religious	Public Secular
1	25	14	1	10
2	25	17	2	6
3	19	10	1	8
4	11	7	1	3
5	17	10	6	1
6	18	4	1	13
7	16	6	3	7
8	9	3	1	5
9	13	3	5	5
10	24	9	5	10
11	21	8	9	4
Total	198	91	35	72

Table A3: Additional Verification of Random Assignment

	(1)	(2)	(3)	(4)
A. NAEA 2008 student-level data	Father - College	Father - Dropout	Mother - College	Mother - Dropout
Private	-0.012	-0.003	-0.013	0.008
	(0.026)	(0.007)	(0.026)	(0.006)
District-year F.Es	Yes	Yes	Yes	Yes
Number of students sampled	4385	4385	4385	4385
R-squared	0.062	0.011	0.070	0.015
Sample year	2008	2008	2008	2008
Grade level	10	10	10	10
B. KEEP student-level data	Percentile rank in school	Often absent from school	Received disciplinary action	Ave. mthly household income
Private	0.353	-0.0004	0.008	1.344
	(2.337)	(0.019)	(0.007)	(16.634)
Metropolitan area F.Es	Yes	Yes	Yes	Yes
Number of students sampled	537	600	600	583
R-squared	0.139	0.013	0.009	0.146
Sample year	2005	2005	2005	2005
Grade level	10	10	10	10

Notes: Panel A reports estimates using the NAEA 2008 grade 10 (first year of high school) student survey data (5% random sample). Welfare is an indicator of whether the student's family is under governmental welfare assistance; Minority is an indicator of whether the student is an ethnic minority; Lunch is an indicator of whether the student receives lunch support; Transfer out is an indicator of whether the student enrolled during the beginning of the academic year later transfers out of the school; College is an indicator of whether the student's parent has at least some college education; Dropout is an indicator of whether the student's parent has less than a high school diploma. Panel B reports estimates (sampling weights adjusted) based on the Korean Education and Employment Panel (KEEP) data. The student's middle school teacher provided information on percentile rank of academic performance, whether the student received any disciplinary action, and whether the student was often absent from school. The student's parent or guardian provided information on average monthly household income. We restrict the sample to students living in the seven major equalization policy metropolitan areas and attending general academic high school in 2005. Because KEEP does not provide school district information, we regress each of the dependent variables against the private school dummy and a set of metropolitan area fixed effects. The results are similar when we restrict the sample to Seoul only, but the sample size is only 256 students. We focus on the major metropolitan areas with equalization policy as it increases the sample size and these areas are more similar than smaller provincial cities. These seven metropolitan areas are Seoul, Pusan, Daegu, Incheon, Gwangju, Daejeon, and Ulsan. School district information is not available in KEEP. Robust standard errors are reported in parentheses. *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

Appendix Table A4

Differences in CSAT Scores between Private and Public School Students

	(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*
	Korean All	Korean Male	Korean Female	English All	English Male	English Female
Private	1.346	1.679	0.919	1.572	1.964	1.134
	(0.518)**	(0.502)***	(0.555)*	(0.614)**	(0.645)***	(0.756)
Observations	189501	99614	89887	189501	99614	89887
R-squared	0.029	0.033	0.026	0.065	0.071	0.060

Notes: Data from 2009 and 2010. We do not use data for 2008 because CSAT results were reported as grade rather than scores. Private school students are more likely to take CSAT than public school students. We replaced the missing scores of individuals who did not take CSAT with the average scores of students of the same gender in the same type of school in the same school district. The standard deviations of both CSAT Korean and English scores are roughly 20 for males and 19 for females. Robust standard errors clustered by school are reported in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Appendix Table A5

The Effects of Private Schooling on Student Outcomes by Gender Type of School

		Male				Female			
	Violence per capita	%College	NAEA-Korean	NAEA-Math	NAEA-English	%College	NAEA-Korean	NAEA-Math	NAEA-English
Single-Sex									
Private	-0.001	0.060	0.122	0.121	0.073	0.051	0.164	0.098	0.110
	(0.000)*	(0.019)***	(0.071)*	(0.062)*	(0.081)	(0.014)***	(0.060)***	(0.054)*	(0.083)
Constant	0.001	0.511	-0.275	-0.014	-0.143	0.581	0.142	-0.105	0.075
	(0.000)***	(0.019)***	(0.068)***	(0.060)	(0.078)*	(0.012)***	(0.056)**	(0.050)**	(0.079)
District-year F.Es	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Number of schools	126	66	31630	31630	31630	60	26878	26878	26878
Sample years	2008-2010	2008-2010	2010	2010	2010	2008-2010	2010	2010	2010
R-squared	0.134	0.520	0.035	0.060	0.083	0.506	0.021	0.035	0.061
Coeducational									
Private	-0.001	0.051	0.069	0.047	0.130	0.032	0.013	0.053	0.046
	(0.000)*	(0.016)***	(0.061)	(0.063)	(0.073)*	(0.014)**	(0.051)	(0.066)	(0.079)
Constant	0.002	0.532	-0.337	-0.081	-0.274	0.629	0.215	-0.087	0.113
	(0.000)***	(0.007)***	(0.020)***	(0.027)***	(0.031)***	(0.006)***	(0.026)***	(0.032)***	(0.040)***
District-year F.Es	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Number of schools	72	72	16936	16936	16936	72	14381	14381	14381
Sample years	2008-2010	2008-2010	2010	2010	2010	2008-2010	2010	2010	2010
R-squared	0.165	0.504	0.023	0.041	0.061	0.500	0.021	0.032	0.064

Notes: We omit results using the percentage of seniors graduated or the percentage of high school dropout as the dependent variable because private and public schools do not differ in these outcomes. We do not split violence per capita by gender because the data were not reported by gender at www.schoolinfo.go.kr. Robust standard errors clustered by school are reported in parentheses. *** p<0.01, ** p<0.05, * p<0.1