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KDI Journal of Economic Policy

Provided in Cooperation with:
Korea Development Institute (KDI), Sejong

Suggested Citation: Park, Yoon Soo (2016) : Autonomy, Incentives, and School Performance: Evidence from the 2009 Autonomous Private High School Policy in Korea, KDI Journal of Economic Policy, ISSN 2586-4130, Korea Development Institute (KDI), Sejong, Vol. 38, Iss. 3, pp. 1-15, https://doi.org/10.23895/kdijep.2016.38.3.1

This Version is available at:
https://hdl.handle.net/10419/200791

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KDI Journal of Economic Policy 2016, 38(3): 1–15

Autonomy, Incentives, and School Performance: Evidence from the 2009 Autonomous Private High School Policy in Korea†

By YOONSOO PARK*

Improving the quality of school education is one of the key policy concerns in Korea. This paper examines whether providing schools with adequate autonomy and incentives can meet the policy goals by looking at a recent policy reform in Korea. In 2009, the Korean government granted autonomy to certain private high schools on the condition that no financial subsidies would be provided to the schools. Because the autonomous private high schools cannot receive a subsidy, they have a strong incentive to meet parental demands because schools failing to meet these demands will lose students and will have to close. Applying the value-added model to longitudinal data at the student level, I find that students entering these autonomous schools show faster growth in their academic achievement than their peers in traditional non-autonomous schools. These results suggest that providing schools with autonomy and incentives can be a useful policy tool for improving school education.

Key Word: Autonomous Private High School, School Effect, Academic Achievement, School Autonomy, Secondary Education in Korea
JEL Code: I20, I28, C21

I. Introduction

Improving the quality of education is one of the key policy concerns in Korea. A traditional approach is to provide more resources to schools, though there is growing evidence that such an input-oriented policy is not an effective means of improving school education. One explanation of the failure of such input-oriented policies is that they often fail to provide schools with adequate autonomy and

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* Received: 2016. 3. 18.
* Referee Process Started: 2016. 4. 1.
* Referee Reports Completed: 2016. 6. 29.
† This paper is a revised version of Park (2014).

incentives to use their resources efficiently and thus improve their educational output. For example, Barrera-Osorio *et al.* (2009) found that providing schools with autonomy has become a popular educational reform in both developed and developing countries in recent years. Hanushek (2003) reviewed many education policies around the world and concluded that creating incentives is much more effective than simply increasing inputs to schools.

This paper investigates whether, and to what extent, providing schools with adequate autonomy and incentives improves the quality of education by looking at a recent policy reform in Korea, referred to here as the autonomous private high school policy of 2009. Traditionally, private high schools in Korea have been heavily subsidized and regulated by the government. For example, private schools cannot select their own students, cannot charge higher tuitions than public schools, and must follow the uniform national curriculum. In exchange for these regulations, any financial deficits in the operating costs of private schools are fully refunded by the government. Perhaps naturally, some commentators argue that private schools have little incentive to improve their teaching technology and make efforts to meet parental demands given the strong governmental control and support (Kim and Lee 2003).

To provide better incentives to private high schools, the Korean government introduced a new type of school, termed the "autonomous private high school", in 2009. As the name suggests, these schools are characterized by a certain level of autonomy in school management in the absence of financial subsidies from the government. Because they receive no governmental subsidies, they have a strong financial incentive to meet parental demands, as schools failing to do so will lose pupils and will likely to close. Thus, one may consider the introduction of these autonomous schools as an opportunity to investigate whether, and to what extent, providing schools with autonomy and incentives -can induce them to improve the quality of their education.

To understand how autonomy and related incentives affect school performance, I compare academic achievement levels in three subjects (Korean, math, and English) of students attending autonomous schools with that of their peers who attend traditional non-autonomous schools using the value-added model suggested by Todd and Wolpin (2007). The results show that students at autonomous schools tend to show more rapid growth in academic achievement than their peers at traditional non-autonomous schools in all three subjects. To assess whether the estimated gap in achievement growth is spuriously driven by non-school educational inputs such as private tutoring, I include the amount of private tutoring expenditures as an additional control variable. In addition, in order to check whether the estimated autonomous school premium is spuriously driven by the unobserved pre-determined academic quality of the students, I also perform a falsification test using pre-determined test scores as (falsified) dependent variables. The results suggest that the estimated gap in achievement growth is mainly attributable to the type of school the students attend and not by private tutoring expenditures or the unobserved pre-determined quality of the students for Korean and math subjects. However, the parallel results for the subject of English suggest that the estimated gap in achievement growth may not reflect a causal impact. These results provide valuable but tentative evidence indicating that providing

adequate incentives and autonomy to schools may be a useful policy tool for improving school education.

II. Institutional Background and Related Literature

A. *Autonomous Private High School Policy*

Since the 1970s, most high schools in Korea have been heavily regulated and subsidized by the government. The high school equalization policy of 1974 required that virtually all high schools in large cities, either private or public, follow a set of governmental rules which outlined nearly all aspects of their operation. For example, all high schools under the equalization policy must follow a uniform national curriculum, cannot select their own students, must charge tuition amounts set by the government, and must recruit teachers and principals certified by the government. Given that the equalization policy mandated private schools to charge an equal amount of tuition - to that of public schools, any deficits in the operating costs of private schools were fully refunded by the government. Consequently, private schools became nearly "public" in their operation, and this raised serious concerns about the lack of diversity and incentives in school education (e.g., Kim and Lee 2003).

In an attempt to diversify school education and spur competition among schools, the Korean government introduced the autonomous private high school policy in 2009. In this policy, autonomous private high schools are granted a greater degree of autonomy in their operation compared to traditional non-autonomous high schools. Essentially, these schools have substantial autonomy in many aspects of school management, including student/teacher/principal recruitment, tuition amounts, curriculum, textbooks, and academic terms (i.e., their choice of semester, trimester, or quarter systems). However, in order to enjoy this autonomy, the schools must bear the following responsibilities. First, autonomous schools cannot receive any financial subsidies from the government. Thus, they have a strong incentive to meet parental demand because schools failing to enroll enough students will not be able to finance their operations and will thus have to close. Second, they cannot charge more than three times the tuition of traditional non-autonomous schools. Third, they must reserve at least 20 percent of their places for students from low-income families. Fourth, they are allowed to select their own students, but not through entrance exams or interviews about academic knowledge. Instead, autonomous schools may select their students according to middle school grades, (non-academic) interviews, recommendation letters, and a lottery system. Particularly, the autonomous schools in Seoul in 2013, which constitute the main subject of this study, select their students in a lottery among applicants whose middle school grades are above the 50th percentile within their middle schools. Finally, the licenses of the autonomous schools must be re-evaluated by the local government (i.e., the education superintendent) every five years. If the schools do not pass this evaluation, they are converted to traditional non-autonomous schools.

Between 2009 and 2011, the Korean government designated 49 autonomous

private high schools, mostly from existing traditional non-autonomous schools across the nation. More than half (25 out of 49) of the autonomous schools operate in Seoul, and the present study focuses on these. Since the introduction of autonomous schools, however, there has been heated debate as to whether the autonomous private high school policy should be maintained. Advocates of the policy argue that it can improve the overall quality of school education by spurring competition among schools. In contrast, opponents emphasize that autonomous schools can deteriorate the educational equity by providing better educational services only to those who can afford higher tuition levels of the autonomous schools. Particularly, as candidates pledging to abolish autonomous schools were elected in many cities and provinces in the 2014 local education superintendent elections,[1] the conflict between advocates and opponents became even more serious. These conflicts garnered media headlines and were followed by a series of lawsuits involving parents, autonomous schools, local education superintendents, and the central government (i.e., the Ministry of Education).

B. *Empirical Studies of Autonomous Private High School*

In spite of the heated debate, surprisingly little is known about how autonomous schools affect the educational performance of students. Kim and Namkung (2014) evaluated the impact of autonomous private high schools on the academic achievement of their students. They compared the educational performance of students in autonomous schools with that of their peers in traditional non-autonomous schools after controlling for students' family backgrounds. They conclude that there is a large gap in academic achievement (with standard deviations of approximately 0.6~0.7 and 0.7~1.0 for reading and math, respectively) between the two types of schools. However, given that autonomous schools select students based on their middle school grades, recommendations, interviews and related factors, there may be unobserved differences in students' pre-determined academic quality levels that are not captured by their family backgrounds. In this respect, the estimated autonomous school premium reported by Kim and Namkung (2014) is likely to be overestimated.

Lee and Shin (2014) attempt to evaluate the spillover effect of autonomous schools. Specifically, they estimate how the designation of autonomous schools affects the academic achievement of the incumbent students in these schools (i.e., students entering the autonomous schools before the designation) and the incumbent students in the closest non-autonomous schools (i.e., students entering neighboring non-autonomous schools before the designation). They found that the designation of an autonomous school does not affect the academic achievement of incumbent students within the schools, whereas itnegatively affected the academic achievement of students in neighboring non-autonomous schools.

This study contributes to the literature by examining how autonomous schools affect the academic achievement of students. Although understanding whether and

[1]Out of 17 local education superintendent elections, candidates pledging to shut down autonomous schools won 13 elections, including that in Seoul. The exceptions were Daegu, Ulsan, Daejeon, and Gyungbuk.

to what extent autonomous schools can improve the academic achievement of students would be the first step towards an evaluation of the desirability of the policy, there is surprisingly little evidence on this issue. Kim and Namkung (2014) reported a large impact, but their estimates are likely to be upwardly biased. Lee and Shin (2014) analyzed the spillover effect of autonomous schools but not the direct effect (i.e., how they affect students who enrolled in them after the designation), which constitutes the main objective of this study.

III. Data

My empirical analysis relies on the Seoul Education Longitudinal Study of 2010 (SELS 2010). SELS 2010 has tracked three cohorts (students in the fourth, seventh, and tenth grades as of 2010) of pupils in Seoul annually since 2010. Table 1 summarizes the survey timings of SELS 2010.

Among the three cohort samples, I use the seventh-grade sample in this study. As shown in Table 1, students in the seventh-grade sample were surveyed from the seventh grade (i.e., their first year of middle school) to the eleventh grade (i.e., their second year of high school). This allows an estimation of the effect of attending an autonomous private high school on academic achievement after controlling for pre-determined achievement as measured during the middle school years.

I restrict my estimation sample to students who entered either autonomous private high schools or traditional non-autonomous high schools. Students who entered vocational and special-purpose high schools are excluded from the estimation sample because these schools are considerably different from autonomous and non-autonomous schools in many aspects of school operation other than incentives.

For outcome variables, I consider test scores in Korean (reading), math, and English. The test scores were originally recorded on a scale of 100. I standardize these scores by subtracting the means and dividing by the standard deviations, with the results used as outcome variables.

Table 2 summarizes the descriptive statistics of my sample. The table clearly shows that students in autonomous schools tend to perform better than their peers in traditional non-autonomous schools. The achievement gap between the two groups ranges from approximately 0.7 to 1.0 in terms of the standard deviation in both the tenth and eleventh grades. However, it should be noted that students at autonomous high schools had outperformed their peers in traditional non-autonomous high schools *before* entering their high schools. Table 2 clearly shows that the students at autonomous high school had already scored higher than their

TABLE 1—SURVEY YEARS OF THE SEOUL EDUCATIONAL LONGITUDINAL STUDY 2010 (SELS 2010)

School level	Elementary School			Middle School			High School		
Cohort sample	Grade								
	4th	5th	6th	7th	8th	9th	10th	11th	12th
Fourth-grader sample	2010	2011	2012	2013	2014				
Seventh-grader sample				2010	2011	2012	2013	2014	
Tenth-grader sample							2010	2011	2012

TABLE 2—SUMMARY STATISTICS

Variable	Autonomous			Non-autonomous		
	N	Mean	S.D.	N	Mean	S.D.
Eleventh-grade test score (Z score)						
Korean	264	0.66	0.94	1990	-0.04	0.96
Math	264	0.80	1.19	1989	-0.09	0.91
English	263	0.82	1.02	1988	-0.09	0.93
Tenth-grade test score (Z score)						
Korean	262	0.71	0.86	1968	-0.05	0.97
Math	264	0.92	0.89	1964	-0.08	0.94
English	263	0.88	0.84	1969	-0.09	0.94
Ninth-grade test score (Z score)						
Korean	270	0.59	0.90	2002	0.08	0.96
Math	269	0.82	0.83	1995	0.08	0.98
English	270	0.72	0.79	2005	0.10	0.95
Eighth-grade test score (Z score)						
Korean	270	0.56	0.81	2009	0.05	0.97
Math	270	0.84	0.87	2009	0.08	0.96
English	270	0.71	0.81	2009	0.08	0.94
Seventh-grade test score (Z score)						
Korean	270	0.52	0.86	2001	0.06	0.96
Math	270	0.77	0.84	1997	0.08	0.94
English	269	0.73	0.80	1999	0.07	0.94
Female (yes=1)	270	0.22	0.41	2007	0.50	0.50
Disabled (yes=1)	268	0.02	0.14	2005	0.04	0.19
Number of siblings	270	2.08	0.41	2000	2.14	0.52
First-born (yes=1)	269	0.10	0.30	1988	0.12	0.33
Single parent (yes=1)	270	0.05	0.21	2008	0.09	0.29
Father's education (yes=1)						
Less than high school	270	0.01	0.09	1935	0.03	0.16
Some college	270	0.10	0.30	1935	0.13	0.34
College graduate	270	0.51	0.50	1935	0.44	0.50
Graduate school or more	270	0.21	0.41	1935	0.11	0.31
Mother's education (yes=1)						
Less than high school	268	0.02	0.14	1977	0.03	0.16
Some college	268	0.15	0.36	1977	0.16	0.37
College graduate	268	0.47	0.50	1977	0.34	0.47
Graduate school or more	268	0.10	0.30	1977	0.04	0.18
Father's age (yes=1)						
49 or younger	267	0.04	0.20	1931	0.06	0.23
60 or older	267	0.12	0.33	1931	0.12	0.33
Mother's age (yes=1)						
49 or younger	269	0.23	0.42	1986	0.23	0.42
60 or older	269	0.03	0.18	1986	0.04	0.20
Parents' employment (yes=1)						
Only mother employed	269	0.05	0.22	2001	0.07	0.26
Both employed	269	0.44	0.50	2001	0.52	0.50
Neither employed	269	0.00	0.00	2001	0.01	0.08
Parental income (10,000 KRW/month)	270	586.02	421.76	2009	497.53	522.05
Parental income missing (yes=1)	270	0.02	0.15	2009	0.04	0.20
Male-only school (yes=1)	270	0.71	0.46	2009	0.31	0.46
Female-only school (yes=1)	270	0.12	0.32	2009	0.34	0.48
Private school (yes=1)	270	1.00	0.00	2009	0.65	0.48
Eleventh-grade private tutoring (10,000 KRW/month)						
Korean	234	12.00	24.29	1745	6.25	11.52
Math	246	34.38	29.48	1814	22.38	23.25
English	245	26.22	38.64	1803	18.16	22.41
Tenth-grade private tutoring (10,000 KRW/month)						
Korean	221	9.63	26.02	1635	6.47	11.36
Math	255	33.04	30.75	1855	22.56	23.49
English	242	25.69	30.74	1814	20.00	23.02

non-autonomous high school counterparts by about 0.6 ~ 0.9 standard deviations during their middle school years (i.e., their seventh, eighth, and ninth grades).

In terms of student characteristics, the proportion of female students is substantially lower in the autonomous schools (22%) than in the traditional non-autonomous schools (50%). This is largely because most of the autonomous schools in Seoul are male-only schools. Among the 25 autonomous schools operating in Seoul in 2013, 17 are male-only schools, five schools are co-educational, and only three schools are female-only schools. To account for this difference in gender composition between the autonomous schools and the non-autonomous schools, I control for gender and for the gender composition of the schools (i.e., male-only, female-only, and co-educational) in my regression analysis. In terms of family characteristics, students in the autonomous schools report higher parental income and educational attainment levels than their peers in traditional non-autonomous schools. Additionally, students in autonomous schools outspend their counterparts in traditional non-autonomous schools on private tutoring.

IV. Empirical Analysis

A. *Identification Issue*

Ideally, the causal effect of attendance at an autonomous school on student outcomes could easily be identified if admissions to autonomous schools were randomly determined. In fact, in 2013, the autonomous schools in Seoul admitted students *by lottery*. This indicates that, *among the participants in the applicant lottery,* admissions to the autonomous schools were randomly assigned. However, whether a student applied for entry into an autonomous school was clearly non-randomly determined. In 2013, only top 50 percent of students in terms of their middle school grades were able to apply for entry into an autonomous school. In addition, autonomous schools charged two to three times the tuition of non-autonomous regular high schools. These facts suggest that the identification of a causal effect of attending an autonomous school depends on how much one can control for middle school grades and the parental income of students as well as their preferences for an autonomous school.

B. *Empirical Model*

To address these concerns, I attempt to identify the autonomous school premium by controlling for ninth-grade (i.e., the third year of middle school) test scores of students along with other background characteristics that are likely to be correlated with their application decisions. Specifically, I estimate the following "value-added" model:

$$(1) \quad Y_{i,m,s,10th} = \beta_0 + \beta_1 Autonomy_s + \beta_2 Y_{i,m,s,9th} + X_{i,9th}\beta_3 + W_s\beta_4 + \rho_m + \varepsilon_{i,m,s,10th}$$

In equation (1), $Y_{i,m,s,10th}$ indicates the tenth-grade (i.e., first year in high school) test scores of student *i* in high school *s* who graduated from middle school *m*. $Autonomy_s$ is a dummy variable that takes a value of 1 if high school *s* is an autonomous school and 0 otherwise (i.e., a traditional non-autonomous school) as of the year 2013.[2] $Y_{i,m,s,9th}$ represents the ninth-grade (i.e., third year in middle school) test scores of student *i*. The lagged test scores are intended to capture the minimum required condition to apply for entry into an autonomous school (i.e., the top 50% in terms of middle school grades) and the difference in the pre-determined academic quality of students between the autonomous and the non-autonomous schools. $X_{i,9th}$ refers to the baseline characteristics of student *i* measured in the ninth grade when the student decided upon the high schools to which he would apply. Specifically, $X_{i,9th}$ includes variables on student characteristics (gender, disability, birth order) and family background (parental age, parental education, parental employment status, parental income, number of siblings, single parent). ρ_m represents middle school fixed effects, capturing any unobservable heterogeneity that students from the same middle schools have in common. In Seoul, nearly all students graduating from their elementary schools are assigned to their neighborhood middle schools. This suggests that ρ_m will also contain a substantial amount of information on the students' residential locations. W_s refers to the characteristics of high school *s*, such as the gender composition (co-educational, male-only, female-only) and the establishment type (private or public). Given that autonomous schools are all private and mostly single-sex schools, controlling for these characteristics is particularly important for distinguishing the effect of school autonomy. Finally, $\varepsilon_{i,m,s,10th}$ is an error term.

C. *Estimation Results*

I begin by estimating equation (1) with OLS, clustering standard errors at the middle school level. Table 3 shows the estimation results when the Korean, math, and English test scores are used as outcome variables. Column (1) of Table 3 shows the simple regression results without any covariate, which basically compares the average test scores of autonomous school students with those of non-autonomous school students. On average, students in autonomous schools achieve higher test scores than their peers in traditional non-autonomous schools by about 0.76, 1.00, and 0.97 standard deviations in Korean, math, and English, respectively. In column (2), I include student characteristics (gender, disability, first-born child), family characteristics (number of siblings, single parent, parental age, parental education, parental employment status, and parental income), high school characteristics (gender composition, establishment type), and dummies for the middle schools from which the students graduated (i.e., middle school fixed effects) as control

[2]Because all students in my estimation sample graduated from their middle schools in February of 2013 and entered their high schools in March of 2013, the year 2013 corresponds to the first year they were in high school.

TABLE 3—ESTIMATION RESULTS FOR THE TENTH-GRADE (FIRST YEAR IN HIGH SCHOOL) TEST SCORES

	(1)	(2)	(3)	(4)	(5)
Estimation	OLS	OLS	OLS	2SLS	2SLS
Covariates	None	Student, family, school characteristics	(2) + 9th grade test scores	Same as (3)	(4) + private tutoring expenditures
			A. Korean test scores		
Autonomous school	0.760***	0.688***	0.393***	0.176**	0.175**
	(0.057)	(0.065)	(0.057)	(0.080)	(0.088)
Observations	2,230	2,061	2,056	2,049	1,675
R-squared	0.062	0.265	0.500	0.308	0.299
First-stage F				453.4	327.9
			B. Math test scores		
Autonomous school	1.003***	0.877***	0.505***	0.320***	0.311***
	(0.059)	(0.068)	(0.059)	(0.076)	(0.073)
Observations	2,228	2,059	2,047	2,037	1,899
R-squared	0.107	0.252	0.551	0.419	0.432
First-stage F				694.9	625
			C. English test scores		
Autonomous school	0.969***	0.839***	0.527***	0.331***	0.346***
	(0.056)	(0.063)	(0.055)	(0.066)	(0.065)
Observations	2,232	2,063	2,061	2,052	1,862
R-squared	0.101	0.341	0.575	0.401	0.387
First-stage F				699.7	625.6

Note: Robust standard errors clustered at the middle school level are in parentheses (*** p<0.01, ** p<0.05, * p<0.1). Student, family, and school characteristics include gender, disability, first-born child, number of siblings, single parent, parental age, parental education, parental employment status, parental income, high school gender composition (male-only, female-only, co-educational), high school establishment type (private, public), and dummies for middle schools from which the students graduated (i.e., middle school fixed effects).

variables. When these characteristics are controlled, the estimated test score gap between the two groups is slightly reduced to about 0.69, 0.88, and 0.84 standard deviations in Korean, math, and English, respectively. These estimates are comparable to those reported in Kim and Namkung (2014) (0.6~0.7 and 0.7~1.0 standard deviations in Korean and math, respectively), who mainly estimated the impact of autonomous schools on the academic achievement of students by regressing test scores on school types after controlling for student, family, and school characteristics. The estimation results in column (2), in conjunction with the results in column (1), also indicate that the student, family, and school characteristics can only account for approximately 10% of the observed test score gap between autonomous school students and non-autonomous school students.

Exploiting the longitudinal structure of my data, in column (3) I include students' pre-determined academic quality levels as measured by their ninth-grade (i.e., third year in middle school) test scores as controls added to the list of controls used in column (2). As discussed in the chapter II, only the top 50% of students in terms of their middle school grades could apply for entry into autonomous schools. Hence, students in autonomous schools are likely to perform better than their peers in non-autonomous schools even before they enter high schools. Adding lagged test scores as an additional control could control for this differences in the pre-determined academic quality levels between the two groups. When the baseline test scores are further controlled, the estimated achievement gap between the two

groups is reduced substantially to about 0.39, 0.51, and 0.53 standard deviations in Korean, math, and English, respectively. These results suggest that Kim and Namkung (2014) likely overestimated the achievement effect of the autonomous schools by ignoring the differences in the pre-determined academic quality between the autonomous school students and the traditional non-autonomous school students.

In columns (1) to (3), I estimated equation (1) with the OLS method using different sets of covariates. Econometrically, however, estimating equation (1) with OLS will result in an inconsistent estimate when the error term $(\varepsilon_{i.m.h.10th})$ is serially correlated with its lagged term $(\varepsilon_{i.m.h.9th})$ because equation (1) includes a lagged dependent variable $(Y_{i.m.h.9th})$ as a regressor. To address this issue, I instrument the potentially endogenous ninth-grade test scores $(Y_{i.m.h.9th})$ with seventh-grade test scores $(Y_{i.m.h.7th})$. This allows the error term $(\varepsilon_{i.m.h.10th})$ to follow a "mild" serial correlation (i.e., AR(1) or AR(2) process) but not a "severe" one (i.e., AR(p) process with p≥3). Column (4) of Table 1, which is my most preferred specification, shows the two-stage least-square (2SLS) estimation results using seventh-grade test scores $(Y_{i.m.h.7th})$ as an instrument variable for ninth-grade test scores $(Y_{i.m.h.7th})$. The impacts of attending an autonomous school on Korean, math, and English test scores are estimated to be 0.18, 0.32, and 0.33 standard deviations, respectively. Comparing these 2SLS estimates with the OLS estimates reported in column (3) reveals that the serial correlation issue discussed above is indeed serious.

Table 2 shows that students in autonomous schools tend to spend more on private tutoring than their peers in traditional non-autonomous schools. To the extent that private tutoring may improve the academic achievement of students, as discussed in a number of recent studies (e.g., Kang, 2012; Ryu and Kang, 2013), the estimated autonomous school premium reported in column (4) of Table 3 could be spuriously driven by the differences in private tutoring investment. To check for this possibility, I add the amount of private tutoring expenditures for each subject as an additional control variable in column (5). Even after controlling for these non-school educational inputs, the estimated autonomous school premium remains similar, indicating that the estimates reported in column (4) are largely attributable to the type of high schools the students attend and not to differences in private tutoring expenditures. Finally, in Table 4, I repeat the above-mentioned analysis using eleventh-grade (i.e., second year in high school) test scores as an outcome variable. Specifically, I estimate equation (1) using $Y_{i.m.h.11th}$ as the left-hand-side variable instead of $Y_{i.m.h.10th}$. The results are roughly similar to those reported in Table 3. In terms of my preferred specification (column 4), attending an autonomous school improve tenth-grade test scores by 0.18, 0.32, and 0.33 standard deviations and eleventh-grade test scores by 0.24, 0.28, and 0.34 standard deviations in Korean, math, and English, respectively.

TABLE 4—ESTIMATION RESULTS FOR ELEVENTH-GRADE (SECOND YEAR IN HIGH SCHOOL) TEST SCORES

	(1)	(2)	(3)	(4)	(5)
Estimation	OLS	OLS	OLS	2SLS	2SLS
Covariates	None	Student, family, school characteristics	(2) + 9th grade test scores	Same as (3)	(4) + private tutoring expenditures
			A. Korean test scores		
Autonomous school	0.700***	0.655***	0.413***	0.242***	0.241***
	(0.062)	(0.070)	(0.061)	(0.075)	(0.079)
Observations	2,254	2,085	2,080	2,073	1,810
R-squared	0.053	0.235	0.424	0.278	0.295
First-stage F				464.5	409.3
			B. Math test scores		
Autonomous school	0.889***	0.730***	0.455***	0.280***	0.256***
	(0.076)	(0.082)	(0.076)	(0.091)	(0.091)
Observations	2,253	2,085	2,072	2,061	1,877
R-squared	0.084	0.186	0.373	0.239	0.252
First-stage F				661.3	643
			C. English test scores		
Autonomous school	0.911***	0.755***	0.500***	0.343***	0.370***
	(0.066)	(0.072)	(0.066)	(0.080)	(0.086)
Observations	2,251	2,082	2,080	2,070	1,875
R-squared	0.088	0.279	0.452	0.315	0.317
First-stage F				697.5	651.1

Note: Robust standard errors clustered at the middle school level are in parentheses (*** p<0.01, ** p<0.05, * p<0.1). Student, family, and school characteristics include gender, disability, first-born child, number of siblings, single parent, parental age, parental education, parental employment status, parental income, high school gender composition (male-only, female-only, co-educational), high school establishment type (private, public), and dummies for middle schools from which the students graduated (i.e., middle school fixed effects).

D. *Falsification Test*

Tables 3 and 4 show that students attending the autonomous schools outperform their peers attending non-autonomous schools after controlling for student, family and school characteristics (including middle school fixed effects), baseline academic performance, and private tutoring expenditures. However, whether the estimated achievement gap between the two groups of students reflects the *causal* effect of attending an autonomous school remains questionable. For example, it is still possible that the estimated achievement gap reflects unobservable differences in pre-determined academic quality levels between the two groups of students.

In order to determine whether equation (1) correctly identifies the causal effect of attending an autonomous school, I perform the following falsification test. Specifically, I estimate the impact of attending an autonomous school on the *pre-determined* academic performance of students. Specifically, I replace the outcome variable of equation (1) with eighth-grade test scores $(Y_{i.m.h.8th})$. Given that the eighth-grade test scores were determined *before* the students entered high school, the autonomous school attendance of students cannot causally affect their eighth-grade test scores.

Table 5 shows the falsification test results. Columns (1) to (3) report positive and

TABLE 5—FALSIFICATION TEST RESULTS FOR PRE-DETERMINED EIGHTH-GRADE (SECOND YEAR IN MIDDLE SCHOOL) TEST SCORES

	(1)	(2)	(3)	(4)	(5)
Estimation	OLS	OLS	OLS	2SLS	2SLS
Covariates	None	Student, family, school characteristics	(2) + 9th grade test scores	Same as (3)	(4) + private tutoring expenditures
	A. Korean test scores				
Autonomous school	0.504***	0.482***	0.210***	-0.050	-0.018
	(0.054)	(0.059)	(0.053)	(0.065)	(0.075)
Observations	2,279	2,109	2,104	2,097	1,444
R-squared	0.028	0.259	0.486	0.144	0.165
First-stage F				483.4	321.2
	B. Math test scores				
Autonomous school	0.753***	0.603***	0.269***	-0.028	-0.040
	(0.057)	(0.065)	(0.055)	(0.071)	(0.075)
Observations	2,279	2,109	2,096	2,085	1,905
R-squared	0.062	0.248	0.519	0.201	0.189
First-stage F				680.1	505.4
	C. English test scores				
Autonomous school	0.633***	0.465***	0.155***	-0.117*	-0.121*
	(0.054)	(0.057)	(0.050)	(0.065)	(0.066)
Observations	2,279	2,109	2,107	2,097	1,893
R-squared	0.046	0.305	0.567	0.222	0.218
First-stage F				725.9	640.5

Note: Robust standard errors clustered at the middle school level are in parentheses (*** p<0.01, ** p<0.05, * p<0.1). Student, family, and school characteristics include gender, disability, first-born child, number of siblings, single parent, parental age, parental education, parental employment status, and parental income, high school gender composition (male-only, female-only, co-educational), high school establishment type (private, public), and dummies for the middle schools from which the students graduated (i.e., middle school fixed effects).

statistically significant impacts of the autonomous high schools, indicating that the corresponding regression equations are likely to be misspecified. On the other hand, in columns (4) and (5), my preferred specifications, I do not find any statistically significant effect for Korean and math. These results suggest that the estimated achievement gaps in the Korean and math test scores reported in columns (4) and (5) of Tables 3 and 4 are not driven by model misspecifications but instead reflect the causal effects of attending an autonomous school. For English test scores, however, the estimates from the falsification test are marginally significant at the 10% level, suggesting that the estimation results for English test scores should be interpreted with caution.

E. *Subgroup Analysis*

As discussed in chapter II, autonomous schools can charge up to three times the tuition of traditional non-autonomous schools in exchange for receiving no governmental subsidies. This feature raises the serious public concern that the autonomous schools can only serve students from high-income families. In this

TABLE 6—ESTIMATED EFFECTS OF ATTENDING AN AUTONOMOUS SCHOOL BY INCOME LEVEL

	(1)	(2)	(3)	(4)	(5)	(6)
		Low-income			High-income	
Outcome variable	10th grade score	11th grade score	9th grade score (falsification)	10th grade score	11th grade score	9th grade score (falsification)
			A. Korean test scores			
Autonomous school	0.107	0.250**	-0.159	0.231**	0.264**	0.034
	(0.158)	(0.107)	(0.131)	(0.106)	(0.112)	(0.107)
Observations	777	832	683	898	978	761
R-squared	0.281	0.337	0.258	0.315	0.291	0.096
First-stage F	135.9	192.8	102.8	209	209	199
			B. Math test scores			
Autonomous school	0.410***	0.285**	-0.001	0.227**	0.221*	-0.027
	(0.099)	(0.138)	(0.123)	(0.095)	(0.120)	(0.089)
Observations	869	858	865	1,030	1,019	1,040
R-squared	0.457	0.241	0.157	0.410	0.248	0.222
First-stage F	274.7	278.4	242.3	364.7	303.9	331.5
			C. English test scores			
Autonomous school	0.282***	0.521***	-0.058	0.378***	0.281**	-0.181*
	(0.097)	(0.114)	(0.081)	(0.088)	(0.112)	(0.095)
Observations	854	861	863	1,008	1,014	1,030
R-squared	0.436	0.419	0.345	0.345	0.249	0.071
First-stage F	332.5	481.4	382.4	252.9	259.3	265.7

Note: Robust standard errors clustered at the middle school level are in parentheses (*** p<0.01, ** p<0.05, * p<0.1). Student, family, and school characteristics of gender, disability, first-born child, number of siblings, single parent, parental age, parental education, parental employment status, parental income, high school gender composition (male-only, female-only, co-educational), high school establishment type (private, public), and dummies for middle schools from which the students graduated (i.e., middle school fixed effects), with the amount of private tutoring expenditures controlled. The low-income group refers to students whose parental monthly income is below KRW 4,500,000. The high-income group refers to those whose parental monthly income is greater than or equal to KRW 4,500,000.

respect, it would be worthwhile to determine how the observed autonomous school premium varies across students' family backgrounds.

To address this issue, I divide the estimation sample into the two subgroups of a high-income sample and a low-income sample. The high-income sample consists of students whose parental income in 2012, when the students were enrolled in the ninth grade, or their third year of middle school, is greater than or equal to or the median (KRW 4,500,000). Accordingly, the low-income sample consists of students whose parental income in the ninth grade is below the median. For each subgroup, I estimate the value-added model of equation (1) using the 2SLS method after controlling for the amount of private tutoring expenditures. This specification is comparable to the regression model used for column (5) of Tables 3, 4, and 5.

Table 6 summarizes the estimation results. Overall, I do not find any clear evidence that the autonomous school premium varies according to students' family backgrounds. These results suggest that the benefits that accrue from school autonomy and incentives can be enjoyed by all students regardless of their family background.

V. Conclusion

In this paper, I estimate the causal effect of attending an autonomous private high school on the academic achievement of students. The autonomous private high school policy has been one of the most controversial educational policy issues in recent years. The 2014 local educational superintendent election sparked much heated debate about whether or not to abolish autonomous schools. The conflicts were followed by a series of lawsuits involving parents, autonomous schools, local offices of education, and the central government (i.e., the Ministry of Education). In spite of these serious conflicts, however, surprisingly little is known about how these autonomous schools affect students. Applying the value-added model by Todd and Wolpin (2007) to the longitudinal data at the student level, I find that autonomous schools more effectively improve the academic achievement of students by approximately 0.2 ~ 0.3 standard deviations relative to traditional non-autonomous high schools. A key feature of the autonomous schools is that they can operate free from governmental control but at the cost of foregoing financial subsidies from the government. Because autonomous schools do not receive governmental subsidies, they have a strong financial incentive to improve the quality of their education, as schools failing to do so will lose pupils and will likely close as a result. In this respect, the estimated autonomous school premium suggests that providing schools with adequate autonomy and incentives can induce them to become more productive.

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