

Effects of Education Policies and Institutions on Student Performance

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Using panel estimates from the Program for International Student Assessment dataset, this study examines how education policies work as the quality of institutions improves. The findings suggest that autonomy over budget-related decisions positively affects the overall performance of students as the quality of institutions improves, whereas autonomy over academic decisions has an ambiguous effect. Considering that country-level institutions interact with school autonomy, the performance of low-ranking students is improved by providing schools with enough power to decide on academic course content and textbooks. Meanwhile, providing schools with great autonomy over budget-related decisions benefits high-ranking students.

Keywords: Education system, Education policy, School autonomy, Democracy, Governance effectiveness, Control of corruption

JEL Classification: H75, I28, O15

I. Introduction

Individual abilities that form the human capital stock are defined in various ways. Within the school system, individual abilities are measured by the performance of an individual in an official test. Government and school authorities are constantly attempting to improve the capabilities of students and in turn produce highly qualified human capital that can drive economic growth. The education system is thus established

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with consideration of the factors that influence student performance.

Empirical studies have developed an education system model, in which authorities can adjust various factors to improve the capability of students. The suggested factors include expenditure per student, class size, pupil-teacher ratio, financial support from the government, and school autonomy on various decisions. Existing studies have analyzed the relationship between the education system and student performance using inner-school factors, such as those mentioned above (Hoxby 2000; Hanushek *et al.* 2013).

The current study starts by exploring the notion that the education system depends not only school factors but also on social norms that rule the overall economy and politics in societies. Government and education authorities have developed an education blueprint to produce the desired human capital by implementing appropriate education policies and manipulating the school system. In particular, school autonomy has a direct correlation with the actions of the government. Therefore, the effects of these factors on student performance vary depending on the nature of the institution. If an education administration is open and decentralized, then various groups become involved in planning the education policy. In such a case, the effects of uniform education instructions from the government cannot be maximized as intended. Meanwhile, school autonomy in centralized societies cannot effectively improve student performance.

On the basis of this idea, this study introduces the quality of institutions into the general education production function employed in the work of Hanushek *et al.* (2013). Democracy, governance effectiveness, and control of corruption are adopted as institutional variables to highlight the indirect influence of social quality on the education system. In addition, this study conducts estimations of each percentile group of students so that different approaches for different groups of students could be suggested.

School autonomy over academic, budget, and teacher-hiring issues are all important, as cited in the studies of Wößmann (2003) and Hanushek (2013). However, the present study finds that autonomy over budget plays an important role in student achievements when institutional variables are controlled. Moreover, a different education policy is suggested based on the level of students, that is, academic autonomy works remarkably well for those who belong to lower percentile groups while budget autonomy improves high-ranking groups.

The next section presents a review of previous literature. Section III

discusses the underlying conceptual framework and develops an empirical model. Section IV describes the dataset used in this study. Section V presents the estimation and additional test results. Section VI provides the conclusions for this study.

II. Literature review

The education performance of students reflects education quality. This topic has been extensively studied, and the findings of these studies have examined the factors that affect the education system as reflected in their output, which is the quality of students. Previous empirical works have constructed an education production function. Generally utilized forms include family background as an explanatory variable.

Hanushek (1992) states that the annual achievement growth of each student declines when they have more siblings. The work behavior of mothers has no apparent effect on the achievement of their children, and the income level of parents does not significantly affect the performance of their children. Wößmann (2005) shows that the education level of parents is positively related to the achievement of their children. In addition, the influence of family background on student performance is more evident in East Asia than in Western countries, such as the United States and those in the European region.

Several studies have focused on school resources as the main determinants of student performance. One of the frequently adopted variables is class size. Hoxby (2000) utilizes the two-stage least squares method to adjust the biased results of the existing education production function because of the unobserved parental characteristics when school resources are analyzed. The adjusted result still implies that class size is negatively related to student performance. Card and Krueger (1996) investigates the influence of school resources on education quality by comparing two states, namely, North Carolina and South Carolina. The result suggests that a wide gap in the pupil-teacher ratios of the groups leads to a wide gap in education level. A low pupil-teacher ratio positively affects student performance.

Morgan and Sirageldin (1968), Johnson and Stafford (1973), Wachtel (1976), and Rizzuto and Wachtel (1980) use total expenditures per student as an index of education quality. However, Card and Krueger (1992) posits that teacher salaries and pupil-teacher ratio should both be considered because a large amount of education expenditures are spent on

salaries; the amount of salaries per teacher is related to pupil-teacher ratios.

An increasing number of studies have highlighted school-level institutions that influence student performance. Moreover, the literature indicates that not all institutions contribute positive effects. Hoxby (1996) explains that teachers' unions increase school input, such as teacher salaries and books, by raising school budgets. However, productivity is decreased, causing a negative effect on student performance. Rouse (1998) reports that parental choice affects the changes in score gains. Students in the Parental Choice Program, which enables parents to choose to send their children to either private schools or public schools, have faster score gains in mathematics than other students do. Han *et al.* (2014) compare the academic achievements of students based on the type of school they attend (*i.e.*, public or private schools). Public schools are administrated by either the local government or the national government while private schools are managed by either non-profit organizations or foundations. Given the different sources of funding, the study determines that students in private schools have better academic performance than those in public schools.

In contrast to the aforementioned studies, Wößmann (2003) adds school responsibilities on formulating the school budget, purchasing supplies, hiring teachers, and determining teacher salaries as institutional variables. Regression results indicate that school autonomy on process and personnel decisions is positively related to student performance. Conversely, school autonomy on standard settings and performance control has adverse effects on student performance (Bishop and Wößmann 2004).

Clark (2009) considers the relationship between school autonomy and the state government. When schools in the UK were converted to grant-maintained schools, they became funded by the central government and were given power over admissions and other operations. However, the school boards were required to follow instructions provided by the state government. In other words, acquiring school autonomy and financial support is accompanied by instructions from the government (Richards 1992). Therefore, the government becomes an important issue as well because its quality and blueprints affect the education policies that it implements. Hanushek *et al.* (2013) suggest that an interactive autonomy with country-level institutional factors (*e.g.*, democracy, governance effectiveness, and control of corruption) should be investigated. However, no study has empirically examined such interactions.

Using empirical methods, the current study presents the influence of

the interaction between school autonomy and the quality of the government on the quality of the education system. The education production function is defined by adding the indicators of the quality of the government with additional explanatory variables for controlling country-level indices. By adding interaction terms between school autonomy and institutional quality, this study can investigate the effects of these variables on student performance.

III. Empirical strategy

A. Conceptual framework

Various empirical models have been proposed to determine the kinds of factors that affect the quality of the education system as measured by the test scores of students. The education production function approach has been applied to empirical models and has been extended to a wide range of empirical studies. A typical education production function represents student outcomes (*Edu*) as a function of family input (*F*) and school input (*S*); that is,

$$Edu = f(F, S) \quad (1)$$

Hanushek (1992) formulates the function by considering family size and structure, the presence of a father, and the time that parents spend with the students as family inputs and the interactions of teachers with students as school input. Hanushek (2003) extends his study by obtaining the pupil-teacher ratio, the academic background and experience of teachers, and the school budget on education as school inputs. In the study of Wößmann (2003), school factors include additional variables, such as shortage of materials and instruction time. The empirical strategy of Wößmann (2003) differs from those of previous studies because it involves examining the effects of the school system (*Inst*) on education production:

$$Edu = Inst \cdot f(F, S) \quad (2)$$

Hanushek (2013) follows the concepts by focusing on the role of school autonomy among the school system variables used by Wößmann (2003). The former analyzes the effects of the local capacity of deciding academic content, budget formulation, and personal management on

the achievement of students.

In the current study, the author introduces additional ideas by emphasizing that the quality of the education system is affected by country-level institutional factors and that the school system represented by autonomy interacts with these factors as mentioned in the previous section. In this study, school autonomy is reclassified as a school factor, which has been assumed to be an institutional factor in previous studies. Meanwhile, country-level institutional factors replace the variable “Inst” in Equation (2).

B. Empirical model

To test the influence of institutions on the quality of education and its interaction with the school system, the author considers the education production function framework described previously and employs a fixed effect estimation. A linear formulation is introduced as follows:

$$Edu_{it} = \alpha_0 + \alpha_1 Inst_{it} + \alpha_2 C_{it} + \alpha_3 S_{it} + \mu_t + \mu_i + \varepsilon_{it}, \quad (3)$$

where Edu_{it} denotes the quality of education as measured by the achievement of students in country i at time t . $Inst_{it}$ measures the quality of institutions in terms of *democracy* (*demo*), *governance effectiveness* (*goveff*), and *control of corruption* (*concorr*). C_{it} is the vector of country factors, such as the *ratio of government expenditure on education* (*govexp*) and the *log of GDP per capita* (*lnGDP*), which controls the country-level institutional factors. S_{it} stands for school factors, such as *pupil-teacher ratio of secondary schools* (*ptsec*), *availability of teachers* (*teachers*), and *school autonomy over academic decisions* (*autoacademic*) and *over budget allocation decisions* (*autobudget*). In contrast to the studies mentioned previously, the present study does not consider family factors because the effects of these factors are considered insignificant in the country-level estimation. Moreover, family factors are not within the scope of this study. μ_t denotes time-fixed effects that are common to all countries, and μ_i denotes country-specific fixed effects that are time-invariant.

Equation (3) only investigates the direct effects of institutions on the quality of education. Therefore, an interaction term between the quality of government institutions and school autonomy is added in the following:

$$Edu_{it} = \alpha_0 + \alpha_1 Inst_{it} + \alpha_2 C_{it} + \alpha_3 S_{it} + \alpha_4 Inst \times SS_{it} + \mu_t + \mu_i + \varepsilon_{it}, \quad (4)$$

where SS_{it} denotes a vector of factors that are considered to be related to the quality of government institutions among the school factors used in Equation (3). Two variables from school factors, namely, academic autonomy and budget allocation autonomy, form the interaction term.

The direct and indirect effects of school autonomy on the quality of education are examined in this model. The interaction terms are generated for each institutional factor. Through them, analysis can be conducted to determine the extent to which school autonomy indirectly affects the quality of education through institutions.

IV. Data

The main dataset used in this study is dependent on the Program for International Student Assessment (PISA), which is an internationally standardized assessment conducted by the Organization for Economic Cooperation and Development (OECD). Targeting 15-year-old students in each country, the PISA examines a range of relevant skills and competencies. The subjects included in the test are mathematics, science, and reading.¹ Variables from the results in 2000, 2003, 2006, 2009, and 2012 are merged into one dataset. As the achievements of international students are only available from the PISA,² the sample countries are limited to those that participated in the assessments. Furthermore, the waves of analyzed dataset are limited to the periods in which the PISA test was conducted.

In the current work, the dependent variable is measured by the test scores in mathematics, science, and reading. The weighted mean of the scores in these subjects was used, assigning the largest weighted value to mathematics and the smallest weighted value to reading. Other additional surveys are conducted to collect background information on each student and school. Questionnaires are distributed to teachers to mea-

¹ Four assessments were conducted in the following years: 2000, 2003, 2006, and 2009. A total of 27 OECD countries and 16 non-OECD countries participated in the assessment in 2000. In 2003, 30 OECD countries and 10 non-OECD countries participated. A total of 30 OECD countries and 27 non-OECD countries implemented the project in 2006. In 2009, 74 economies, including 34 OECD countries, implemented the program. The latest assessment in 2012 involved more emerging economies and few OECD countries. However, the results of this assessment were excluded in the study because the dataset only became available in December 2013.

² The PISA test is the only standardized test that compares the performance of students from several countries.

sure several school factors.

School autonomy is a key variable to be examined because it plays an important role in the school system and affects the education system through country-level institutions. School autonomy refers to the degree to which agents belonging to each school depend on the local or state government in the decision-making process related to school operations. Two decision-making types are used. First, school autonomy over academic decisions is asked in the questionnaire through the following questions: “In your school, who has the main responsibility for which textbooks are used?” and “In your school, who has the main responsibility for determining course content?” Second, school autonomy over budget allocation depends on the following questions: “In your school, who has the main responsibility for formulating the school budget?” and “In your school, who has the main responsibility for deciding the budget allocations within the school?” Five checkboxes are labeled as follows: not a school responsibility, appointed or elected board member, principal, department head, and teachers. Except for the checkbox for “not a school responsibility,” the other checkboxes correspond to the decision-making agents who belong to the school system. To measure each type of school autonomy, the sum of the responses of each checkbox is normalized between 0 and 100. The normalized value of the “not a school responsibility” response is subtracted from the total responses to leave the true value that represents school autonomy. Whether the school has any influence on the decision-making process determines the autonomy over academic decisions and budget allocation decisions (Hanushek *et al.* 2013). The lack of school influence indicates that decision making is assumed by external agents who could only generalize the overall decisions among the schools in the country and fail to consider the needs of students and the schools.

Pupil-teacher ratio is obtained from the UNESCO dataset. The availability of mathematics teachers is obtained from the additional PISA surveys. The variable is measured using the question, “In your school, is the learning of <15-year-old students> hindered by a shortage of teachers?”

The operational indicator of democracy, which comes from Polity IV, is derived from the competitiveness of political participation, the openness and competitiveness of the executive, and the constraints on the chief executive. Governance effectiveness and control of corruption are obtained from the governance indicator provided by the World Bank. Governance effectiveness reflects the perceptions on the quality of public and civil services, the degree of its independence from political pres-

TABLE 1
DESCRIPTIVE STATISTICS

	obs.	mean	std. dev.	min	max	source
edu	265	462.04	56.205	311.9	553.9	PISA dataset
govexp	170	13.985	4.153	7.257	30.970	World Bank
lnGDP per capita	263	9.688	1.072	6.297	11.810	World Bank
ptsec	176	13.208	4.530	5.400	32.637	UNESCO
teachers	263	15.702	4.225	0	33.063	PISA dataset
academic autonomy	190	0.726	0.228	0	0.995	PISA dataset
budget autonomy	195	0.769	0.169	0.260	1	PISA dataset
democracy	246	8.533	2.651	0	10	Polity IV
governance effectiveness	265	0.986	0.809	-0.950	2.281	Governance Indicator
control of corruption	265	0.865	1.027	-1.513	2.586	Governance Indicator

Note: "Edu" is the PISA test score. The full names of each variable are as follows: ratio of government expenditure on education (govexp), pupil-teacher ratio of secondary school (ptsec), and availability of teachers (teachers).

tures, and the quality of policy formulation. Control of corruption reflects the perceptions on the extent to which public power is exercised for private gain, including both petty and grand forms of corruption, as well as the perceptions on the rule of the state by elites and private interests.

Table 1 summarizes the descriptive statistics of the variables used in the empirical model and its source. In terms of *teachers*, the average schools in the country suffer greatly from the shortage of school teachers as the value reaches 0. *Autonomy over academic decision (autoacademic)* and *budget allocation (autobudget)* ranges from 0 to 100. If their values are 0, then the average schools in the country do not have any right to decide on academic content or budget allocation but only depend on the local and state government. The *democracy (demo)* indicator is an additive 11-point scale from 0 to 10. *Governance effectiveness (goveff)* and *control of corruption (concorr)* range from -2.5 to 2.5, with the maximum value indicating that the country has strong governance performance.

TABLE 2
CORRELATION BETWEEN EXPLANATORY VARIABLES

	edu	govexp	lnGDP	ptsec	teachers	autoacademic	autobudget	demo	goveff	concorr
edu	1									
govexp	-0.2873	1								
lnGDP	0.6040	-0.2503	1							
ptsec	-0.2258	0.4628	-0.2476	1						
teachers	-0.2176	0.3818	-0.1255	0.3421	1					
autoacademic	0.4004	-0.0260	0.1308	0.2159	-0.0936	1				
autobudget	0.3553	0.0048	0.3131	0.1312	0.0774	0.3572	1			
demo	0.4935	-0.5050	0.3599	-0.1523	-0.2072	0.3561	0.2998	1		
goveff	0.7270	-0.1061	0.8408	-0.1585	-0.1370	0.2800	0.4636	0.4105	1	
concorr	0.6405	-0.0908	0.8024	-0.1466	-0.0745	0.2615	0.4368	0.3915	0.9446	1

The sample size of the analysis ranges from 170 to 265. If all the variables are extracted from the PISA dataset, then the full dataset with 265 observations can be used in the estimations. However, the ratio of government expenditure on education with 170 observations and the pupil-teacher ratio with 176 observations seem to deplete the observations of estimations. These variables come from different sources (*i.e.*, *govexp* from the World Bank and *ptsec* from UNESCO), and their panels are not balanced, causing the estimated observations to decrease to 105 and 107. The correlation among the explanatory variables is presented in Table 2.

V. Estimation results

First, the empirical model of the general education production function from Equation (1) in Section III is estimated to determine how fundamental factors affect student achievement. Column (1) in Table 3 shows the results of the fixed effects. In general, the logarithm of the GDP per capita is positively significant, that is, students from rich countries generally achieve high performance. The ratio of government expenditure on education is insignificant. The availability of teachers has a positive trend but is not significant. However, the pupil-teacher ratio is significant with negative signs, which indicate that students from a small class size can be educated effectively and efficiently. Autonomy over academic decisions is negatively significant as well. The PISA is an internationally standardized assessment; thus, great power is given to the government to decide on the content and the textbooks to be used in schools. This condition leads to students achieving high scores. Therefore, the negative sign of school autonomy over academic decisions is sensible. However, autonomy over budget-related decisions is not significant, although it is negative as well.

To analyze the effects of the quality of institutions and its interaction with school autonomy, institutional variables and their interaction terms with school autonomy are added in the remaining estimations. As proxies for the quality of institutions, democracy is used in column (2), governance effectiveness in column (3), and control of corruption in column (4). As shown in all three estimations, the quality of institutions does not have a direct effect on student performance. By contrast, GDP per capita and pupil-teacher ratio are statistically significant. The availability of teachers is significant when governance effectiveness is introduced.

TABLE 3
RESULTS OF THE PANEL FIXED EFFECTS ON THE INFLUENCE OF
INSTITUTIONS AND SCHOOL AUTONOMY ON STUDENT PERFORMANCE

	(1)	(2)	(3)	(4)
Quality of institutions (inst)		-17.515 (0.175)	-29.232 (0.108)	-22.620 (0.229)
lnGDP per capita	20.420*** (0.008)	13.741* (0.068)	10.286* (0.079)	10.343** (0.020)
Ratio of government expenditure on education	-0.527 (0.629)	-1.783 (0.155)	-0.517 (0.599)	-0.660 (0.487)
Pupil-teacher ratio	-1.669* (0.093)	-1.904** (0.016)	-1.756** (0.017)	-1.666** (0.022)
Availability of teachers	0.530 (0.280)	0.498 (0.301)	0.951** (0.047)	0.797 (0.131)
Academic autonomy (autoacademic)	-0.206* (0.098)	-1.413 (0.161)	-0.212 (0.164)	-0.239** (0.036)
Budget autonomy (autobudget)	-0.044 (0.700)	-1.110** (0.034)	-0.331** (0.013)	-0.135* (0.054)
inst*autoacademic		0.119 (0.231)	-0.049 (0.680)	-0.023 (0.794)
inst*autobudget		0.122** (0.020)	0.537*** (0.000)	0.464*** (0.003)
Number of observations	107	105	107	107
Number of groups	41	40	41	41

Notes: The dependent variable is the quality of education measured from the performance shown in the PISA test. In the wave of 2012, the 2010 dataset is used for the ratio of government expenditures on education, and the 2011 dataset is used for the log of GDP because of the lack of data. Proxies for the quality of institutions are democracy in column (2), governance effectiveness in column (3), and control of corruption in column (4). Robust standard errors are adjusted for 41 clusters at the country level in columns (1), (3), and (4) and for 40 clusters at the country level in column (2).

P-value in parentheses: *p < 0.1; **p < 0.05; ***p < 0.01

However, its effect is not guaranteed because it is insignificant with regard to the other institutional variables, namely, democracy and control of corruption. Different from that in column (1), the role of academic autonomy is ambiguous because it is significant only when control of corruption is used as a proxy for the quality of institutions. The change

in the effects of budget autonomy after the addition of institutional variables is remarkable. As in column (1), it has no role when estimated in a typical education function, but it affects the education system, with country-level institutions additionally being controlled at any case in which proxies are used. It is significant and negative. The low level of budget autonomy indicates that external agents, such as the local or central governments, are in charge of securing the education budget and allocation to schools. Schools have difficulty in employing education and administrative processes autonomously. The result indicating that budget autonomy itself is negatively significant infers that schools with decision-making power over budget-related problems equates to a decreased student performance. Thus, the budget allocated by external agents works effectively and efficiently for schools when used to improve student abilities.

Interaction terms between the quality of institutions and school autonomy variables are also introduced. These terms are the most important because their significance supports the hypothesis of this study, which expects that education policies work indirectly through institutions and directly through student achievements. Looking into the first interaction term, academic autonomy does not seem to work on the education system. Although academic autonomy itself is significant in several estimations, academic autonomy is determined to have no role when it interacts with country-level institutions. However, when budget autonomy interacts with the quality of institutions, the result provides the opposite inference. The interaction term between the quality of institutions and budget autonomy is significantly positive. As the quality of institutions increases, the achievement of students improves if school boards are granted great autonomy over budget formulation and allocation. In the case of democracy denoting the quality of institutions in column (2), the explanations are as follows. A democratic society pursues a decentralized decision-making process and strengthens the autonomy of a school; their interaction positively affects student performance. Hence, democracy becomes a channel for budget autonomy to affect the education system positively. In column (3), the interaction between governance effectiveness and school autonomy over budget formulation and allocation decisions is significantly positive. This result indicates that autonomy over budget allocation works through government effectiveness to affect the education system positively. If the quality of public services improves and the education system becomes increasingly independent from the government, then school autonomy over budget-related decisions creates a positive synergy effect

on education. Academic autonomy has no influence when it interacts with governance effectiveness. In addition, the estimation in column (4) infers that control of corruption is also a channel for school autonomy over budget-related decisions. As the capacity to monitor corrupt activities advances, the education system is effectively improved when the government hands over the authority to deal with budget-related issues to schools. Compared with external agents such as governments, school boards are more aware of the need for budget support to improve the school system. If corruption is eradicated effectively, then finances could be maximized through proper allocation instead of allotting them to unnecessary political activities.

The aforementioned results provide general implications that can be applied to the average education policies aimed at students. However, in practice, the several ways to raise student performance prove that the quality of the education system is good enough to produce a highly qualified labor force. One of these ways is to concentrate on the top-ranking students and assign them to comprise an elite group. Conversely, policymakers can focus on students who score in the middle or bottom percentile to raise the overall average scores. With this idea, the author conducts additional tests to determine whether the effects of institutions and the school system on student performance differ depending on the percentile groups of the scores of students. The PISA dataset provides the average scores at the 5th, 10th, 25th, 75th, 90th, and 95th percentiles; this study conducts estimations at the 5th, 10th, 90th, and 95th percentiles. The fixed effects model is used by considering the average scores of each percentile as a dependent variable. The result is divided into two groups: one is the group of scores from the 5th percentile to the 10th percentile, which represents the case of low-ranking students; and the other group is composed of the scores from the 90th percentile to the 95th percentile, which represents the case of top-ranking students.

Table 4 shows how the quality of institutions and school autonomy influence the performance of low-ranking students at the 5th and 10th percentiles. Proxies for the quality of institutions are democracy in columns (1) and (4), governance effectiveness in columns (2) and (5), and control of corruption in columns (3) and (6). As in the average result in Table 3, the variables of the quality of institutions themselves do not directly affect student performance. The signs of several variables are the same as those in Table 3. The ratio of government expenditure on education and the availability of teachers are still insignificant; the logarithm of the GDP per capita is positively significant

TABLE 4
RESULTS OF THE PANEL FIXED EFFECTS ON THE INFLUENCE OF INSTITUTIONS AND SCHOOL AUTONOMY ON THE
ACHIEVEMENT OF LOW-RANKING STUDENTS

	Percentiles					
	5 th			10 th		
	(1)	(2)	(3)	(4)	(5)	(6)
Quality of institutions (inst)	-29.997 (0.204)	-45.965 (0.303)	-10.234 (0.616)	-26.567 (0.305)	-43.173 (0.301)	-11.548 (0.570)
lnGDP per capita	16.902* (0.057)	17.151* (0.077)	11.901* (0.052)	16.172** (0.030)	16.731** (0.037)	11.607** (0.020)
Ratio of government expenditure on education	-2.548 (0.183)	-1.340 (0.261)	-1.133 (0.346)	-2.401 (0.177)	-1.372 (0.242)	-1.127 (0.314)
Pupil-teacher ratio	-3.108** (0.017)	-2.281** (0.024)	-2.808** (0.014)	-2.763** (0.024)	-2.505** (0.036)	-2.490** (0.022)
Availability of teachers	-1.608 (0.178)	-0.399 (0.616)	-0.298 (0.721)	-1.016 (0.164)	-0.429 (0.568)	-0.323 (0.673)
Academic autonomy (autoacademic)	-3.127*** (0.003)	-0.697*** (0.008)	-0.529*** (0.006)	-2.790*** (0.006)	-0.671*** (0.005)	-0.517*** (0.002)
Budget autonomy (autobudget)	-0.834 (0.215)	-0.059 (0.772)	0.013 (0.941)	-0.786 (0.185)	-0.053 (0.757)	0.007 (0.963)
inst* autoacademic	0.275*** (0.009)	0.388** (0.029)	0.210* (0.057)	0.241** (0.018)	0.353** (0.047)	0.195* (0.076)
inst*autobudget	0.107 (0.147)	0.304 (0.196)	0.312 (0.143)	0.101 (0.132)	0.276 (0.237)	0.300 (0.147)
Number of observations	105	107	107	105	107	107
Number of groups	40	41	41	40	41	41

Notes: Proxies for the quality of institutions are democracy in columns (1) and (4), governance effectiveness in columns (2) and (5), and control of corruption in columns (3) and (6). Robust standard errors are adjusted for 40 clusters at the country level in columns (1) and (4) and for 41 clusters at the country level in columns (2), (3), (5), and (6). P-value in parentheses: *p<0.1; **p<0.05; ***p<0.01.

and pupil-teacher ratio negatively significant. The noticeable results are the variables related to school autonomy. On average, the effects of academic autonomy are ambiguous because a few of them are not significant (Table 3). However, the autonomy over the decision on textbooks and course content is strongly significant and negative regardless of which institutional indicators are used (Table 4). This finding means that the performance of low-ranking students improves when the authority to make academic decisions is given to the government rather than the school board. By contrast, budget autonomy itself does not have any effect on low-ranking students. Next, the interaction terms between the quality of institutions and academic autonomy is positive and significant. Hence, when academic autonomy interacts with the quality of institutions, it positively affects the achievements of low-ranking students. This result differs from that of academic autonomy itself. Thus, if society seeks to achieve growth by improving the quality of institutions, then giving schools great autonomy over academic decisions benefits low-ranking students. However, budget autonomy still does not have any relationship with improving the achievements of low-ranking students even if it relates to the quality of institutions.

Table 5 demonstrates the results of the panel fixed effects on the influence of institutions and school autonomy on high-ranking students. In the case of students in the 90th and 95th percentiles, the quality of institutions, the ratio of government expenditure on education, the GDP per capita, and the availability of teachers are not significant. The pupil-teacher ratio is strongly significant and negative. The results related to school autonomy contradict the estimations for the low-ranking student cases. Academic autonomy itself does not influence high-ranking students. By contrast, budget autonomy is significant. This result differs from that shown in Table 4. The negative sign infers that providing governments instead of school boards with great power to decide on budget-related issues is effective and efficient for low-ranking students. The interaction terms provide clear differences compared with the results on low-ranking students. When the level of the quality of institutions increases, academic autonomy has no effect on high-ranking students. Only budget autonomy indirectly affects high-ranking students through country-level institutions. The sign of budget autonomy itself is negative; however, the sign becomes positive when budget autonomy works through institutions. As the levels of democracy, governance effectiveness, and control of corruption improve, providing school boards with great budget autonomy positively affects the performance of high-ranking students.

TABLE 5
RESULTS OF PANEL FIXED EFFECTS ON THE INFLUENCE OF INSTITUTIONS AND SCHOOL AUTONOMY ON THE ACHIEVEMENT
OF HIGH-RANKING STUDENTS

	Percentiles					
	90 th			95 th		
	(1)	(2)	(3)	(4)	(5)	(6)
Quality of institutions (inst)	-14.461 (0.296)	-20.586 (0.317)	-11.198 (0.632)	-13.759 (0.327)	-20.265 (0.344)	-8.969 (0.708)
lnGDP per capita	-1.911 (0.773)	-0.997 (0.840)	-2.814 (0.681)	-4.387 (0.542)	-3.072 (0.566)	-4.917 (0.495)
Ratio of government expenditure on education	-1.575 (0.252)	-0.557 (0.673)	-0.544 (0.641)	-1.262 (0.409)	-0.219 (0.886)	-0.162 (0.903)
Pupil-teacher ratio	-2.858*** (0.001)	-2.726*** (0.001)	-2.643*** (0.004)	-3.041*** (0.001)	-2.924*** (0.001)	-2.822*** (0.003)
Availability of teachers	-0.520 (0.402)	-0.305 (0.624)	-0.293 (0.565)	-0.488 (0.430)	-0.307 (0.622)	-0.282 (0.587)
Academic autonomy (autoacademic)	-1.097 (0.390)	-0.102 (0.677)	-0.097 (0.513)	-1.030 (0.430)	-0.062 (0.801)	-0.056 (0.705)
Budget autonomy (autobudget)	-0.957** (0.028)	-0.216** (0.018)	-0.138** (0.022)	-0.962** (0.025)	-0.240** (0.011)	-0.168* (0.069)
inst* autoacademic	0.101 (0.420)	-0.007 (0.978)	-0.020 (0.904)	0.097 (0.444)	-0.025 (0.922)	-0.044 (0.793)
inst*autobudget	0.101** (0.041)	0.275*** (0.010)	0.284** (0.015)	0.097** (0.047)	0.262** (0.040)	0.271** (0.013)
Number of observations	105	107	107	105	107	107
Number of groups	40	41	41	40	41	41

Notes: Proxies for the quality of institutions are democracy in columns (1) and (4), governance effectiveness in columns (2) and (5), and control of corruption in columns (3) and (6). Robust standard errors are adjusted for 40 clusters at the country level in columns (1) and (4) and for 41 clusters at the country level in columns (2), (3), (5), and (6). P-value in parentheses: *p<0.1; **p<0.05; ***p<0.01.

VI. Conclusion

In an endogenous growth model, the ideas and inventions created by human capital stock through activities, such as research and development, are the driving forces of economic growth (Romer 1990). To increase growth rate, the government must foster the human capital that positively affects the economy. The government formulates policies and implements instructions to achieve its purpose of accumulating human capital stock. However, such goal can bring considerable burden to schools, which become executive organs. Thus, the quality of a school system differs in terms of the quality of country-level institutions and the pursuits of the government.

This study suggests that different education policies can be implemented depending on the level of institutional quality in society and the level of student abilities. On average, allowing the government to have the power to decide on budget formulation and usage positively influences student performance regardless of the institution level. In the case of academic problems, academic autonomy itself does not seem to directly affect student performance. The effects of the two types of autonomy are similar, considering their interactions with the quality of institutions. As the levels of democracy, effective governance, and corruption control of societies increase, allowing schools instead of the government to have the autonomy to formulate the school budget and decide on its usage highly benefits student performance. By contrast, academic autonomy does not directly influence education through institutions.

For each percentile group, different approaches to education policy are suggested based on the percentile level that the students belong to. A school with little autonomy over academic decisions benefits low-ranking students. However, if country-level institutions are considered and their quality improves, then providing schools with great autonomy over decisions related to academic courses and content is better than receiving academic instructions from the government. In the case of high-ranking students, their performance is effectively influenced by a small degree of budget autonomy. However, if the quality of institutions and public awareness improve, then providing the school board with autonomy over budget formulation and usage instead of over academic decisions is considerably effective.

Although this study has meaningful implications, it has a number of limitations. First, the analysis contains endogeneity because of sample

selection bias. Most of the countries included in the dataset are OECD countries. OECD countries tend to have the highest levels of democracy, which are close to 10. Although Table 2 shows that the correlation between democracy and student performance is 0.4935, which is not as high as the other correlation values, the small sample size and the small variation within the democracy levels across the included countries make it difficult to prove that the analysis does not pose an endogenous problem.

Second, indices from the PISA dataset, such as test scores, the proportion of school budget from the government, academic autonomy, and budget autonomy, are obtained from the simple averages of each country. However, the education policies implemented by a state or a local government can vary in different localities, even those in the same country. Each proxy for the school factors from the PISA dataset does not capture the specific local differences of education systems.

Nonetheless, the PISA questionnaire can be improved by including more detailed information. This addition of considerably accurate and specified information can lead to highly reliable results. Furthermore, additional studies can be conducted based on the different results on the level of institutions and the percentile groups of student performance. The idea can be extended to consider country-level development stages. The quality of governments and institutions, as well as their effects, varies across different developmental stages. The general criterion that divides these stages is the GDP per capita. Through further research on the subject, appropriate education policies for developing, middle-income, and developed countries could be suggested to develop good labor forces that can drive economic growth.

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