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경제학 석사 학위 논문

Institutions and the quality of education

제도가 교육의 질에 미치는 영향에 대한 실증 분석

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Abstract

Institutions and the quality of education

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This paper investigates a channel through which government and institutions affect educational system using PISA dataset. Fixed effects model is utilized. Educational production functions are set for each proxy for institutional quality such as democracy, governance effectiveness, and control of corruption. Interaction term between some of school factors and institutional factors are included to investigate indirect influence of government and institutions on educational system. This study finds that financial support from government and school autonomy over budget related decisions are the channel factors that this paper tries to investigate. According to the results, letting government have more power on deciding educational contents related policies acts as a positive role on students' performance, regardless of the level of institutions. However, implication in the case of financial problem is opposite. As the level of democracy and effective governance of societies increase, allowing schools to have autonomy to formulate school budget and decide the usage of it is better for the quality of education than concentrating budget decision power on government.

Keywords: educational system; democracy; governance effectiveness; corruption; school autonomy

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1. Introduction

In the initial stage, there were limits for explaining economic phenomenon because only easily quantifiable data such as GDP per capita and the amount of investments were used. In fact, there are lots of invisible factors that organize economic activities in the society. Introducing institutional variables into economic analysis is one of the meaningful trials to close the gap between the reality and theoretical analysis in economics. Various indices are established through conducting surveys and used to studies. A major topic that introduced institutional indices is economic growth. Studies dealing with the topic investigate how the quality of institution works on economic growth or development. However, there are few researches studying how institutional factors influence the lives of people living under the political and economic system that is created from the act of institutions. Depending on how institutions work on society, there are lots of changes in the protection of fundamental human rights, education, health, and so on.

This paper focuses on the relationship between institutions and education. Human capital has been one of the most important factors that lead to economic growth. Investigating which factors influence accumulation human capital and the methods of measuring it are actively researched. Educational system is also the main subject for the related studies. Institutions are also considerable factors that formulate educational system which has a direct effect on the quality of human capital.

To investigate the relationship between institutions and educational system, this study uses educational function motivated by Hanushek (2013). It assumes that institutional variables do not only affect educational system directly but also affect it indirectly through school factors. Democracy, governance effectiveness, and control of corruption are introduced as institutional variables. Assumed transmission channels that let institutions influence indirectly on educational system are the proportion of school budget from government, school autonomy over academic decisions, and school autonomy over budget related decisions. The next section gives an introduction of preceding literatures about measuring the quality of human capital and the relationship

between institutions and education. Section 3 discusses the underlying conceptual framework and develops an empirical model. Section 4 describes introduction and process of formulating dataset used in this paper. Section 5 presents this paper's estimation results and additional test results. Section 6 concludes.

2. Literature review

2.1. Measuring the quality of education

A variety of studies have researched the role of human capital in economic growth. Dealing with human capital as an explanatory variable, the main issue is how to measure the relevant variable. In general, former schooling activities are employed as proxies for relevant human capital in common. Romer (1990) considers human capital as the stock of intangible knowledge which creates new designs and technologies. In that sense, he suggests that the cumulative effect of human capital can be measured by years of education or job training. It is presented empirically in various studies. At the initial stages, frequently used measure of human capital is either the primary- or secondary-school enrollment rate (Barro, 1991; Kyriacou, 1991; Lau, Jamison, and Louat, 1991; Levine and Renelt, 1992; Mankiw et al., 1992). Kyriacou (1991) estimates average schooling years using the lagged enrollment ratio of primary school and current enrollment ratio of secondary and higher education and constructs panel dataset with the estimated variables. Lau, Jamison, and Louat (1991) adds accuracy on the former study employing survival rates of population in the procedure of estimating flows of schooling. Mankiw et al. (1992) begins with data on the fraction of the eligible population (aged 12 to 17), enrolled in secondary school. They then multiply this enrollment rate by the fraction of working-age population that is of school age (aged 15 to 19).

However, the variables include measurement errors because the age ranges in the two data series are not the same. Also Hanushek and Kimko (2000) points out that the variable does not present changes in the stock during periods of educational and demographic transition. Barro and Lee (1993) handle the problem by developing better schooling stock variables through individual country survey and census data. The dataset they pioneered is concentrated on educational attainment, measured with the years of completed schooling for persons aged 25 and over. It enables us to focus on educational attainment for the population aged 25 and above, rather than the young aged category or for subgroups of the population such as the labor force or employed persons.

However, their dataset does not adjust school length and does not concern the quality of education.

To deal with the limits that existing measurement procedures do not include the quality of human capital, Hanushek and Kimko (2000) concern the quality of labor force when measuring human capital in growth regression. They provide new measures of human capital based on student cognitive performance on various international tests of academic achievement in mathematics and science. To develop a measure of labor-force quality, they combine all of the information on international student's performance. By mixing the different tests, they try to make relevant human capital variables. The quality of labor-force, so called cognitive skills, is employed to endogenous growth model and the results indicate that it is directly related to labor productivity and growth even when the regression controls schooling years. Inspired by the trial of estimating quality of human capital, variety of studies have extended to examine which factors affect the creation of the human capital quality. As it is a qualitative approach, the performance of students as a proxy for the quality of labor force should be investigated by the factors that influence the quality of educational system.

Previous studies have already used the educational quality variables though they do not define the performance of students as a dependent variable. Morgan and Sirageldin (1968), Johnson and Stafford (1973), Wachtel (1976), and Rizzuto and Wachtel (1980) used total expenditures per student as an index of the quality of education. However, Card and Krueger (1992) suggested pupil-teacher ratio and teacher salaries because a large amount of education expenditures are spent on giving salaries and the amount of salaries per a teacher is related to pupil-teacher ratios.

Taking over the trials to explain school quality, Hanushek (2003) suggests the way to measure educational system input variables to examine the effect of them on the performance of students. Pupil-teacher ratios, education level of teachers, teacher experience, teacher salaries, and expenditure per student are main concerns of this study. After setting dataset, he found that improving the quality of education by concerning the quality of teachers and institutions is more related to students' performance rather than

increasing expenditure on school resources and environment for students. Wößmann (2003) investigates which factors influence on international difference of mathematics and science performance based on international database of more than 260,000 students from 39 countries. An international student-level dataset is set based on the Third International Mathematics and Science Study (TIMSS) that was conducted in 1994/5 under auspices of International Association for the Evaluation of Educational Achievement. He specifies independent variables as family background of students, school resources, and institutions. The results of the study show that most of the family factors (e.g. education level of student's parents and time spent on reading books at home), school resources (e.g. class size, shortage of materials, instruction time, and characteristics of teachers), and institutions (e.g. existence of central examinations and central curriculum, school autonomy, incentives given to students, and influence of parents on institutions) are strongly related to the performance of students. The quality of education is an important factor because labor forces which drive economic growth are produced through it. So, efforts to research on which determinants of the quality of education produce better workforces are essential (Lee and Barro, 2001; Jones and Schneider, 2006; Hanushek and Wößmann, 2008).

2.2. Institutional effects on education

Educational performance of students reflects educational quality. This topic has been widely studied and findings of literatures have examined factors which affect educational systems reflected in their outputs, which is the quality of students. Some studies focus on school resources as the main determinants. They indicate that resources such as expenditure per student (Sander, 1993; Papke, 2005), smaller class sizes (Hanushek, 1999; Hoxby, 2000a; Gundlach et al., 2001), and pupil-teacher ratios (Card and Krueger, 1996; Eide and Showalter, 1998; Duflo et al., 2007) improve students' performance. On the other hand, there is increasing number of studies that highlight institutions that influence student performance. According to following studies, each institution do not always bring positive effects. According to Hoxby (1996), teachers' unions increase school inputs such as teacher salaries and books by raising school budgets. However, the productivity is decreased to have negative effect on student

performance. Rouse (1998) reports parental choice affects the changes of score gains. Students in the Parental Choice Program which enabled to choose whether to enter private or public schools had faster math score gains than other students.

Different from above studies, Wößmann (2003) adds school responsibilities on school budget, purchasing supplies, hiring teachers, and determining teacher salaries as institutional variables. According to the regression results, school autonomy in process and personnel decisions is positively related to performance of students. On the other hand, school autonomy on standard settings and performance control has adverse side effect (Bishop and Wößmann, 2004). Clark (2009) considers the relationship between school autonomy and the state government. When schools in the UK were gradually converted to Grant Maintained (GM), those GM schools were funded the central government and given power over admissions and other operations. Instead, the school boards were required to follow some instructions that the state government provided. School funds from government enable schools to leave controls from local education authority and to make autonomous decision making. (Richards, 1992). That is, acquiring school autonomy accompanies financial supports from government with instructions. In that sense, the government also becomes an important issue because the quality of it and blueprints it affect educational policies that they implement. Hanushek et al. (2013) suggest that interacted autonomy with country-level institutional factors (e.g. democracy, governance effectiveness, and control of corruption) should be investigated. However, no further studies exist that examine the interactions empirically.

This study shows how the interaction between school autonomy and the quality of government influences on the quality of education with empirical models. It defines education production function adding the quality of government indicators with additional explanatory variables to control country-level indices. The level of democracy, governance effectiveness, and corruption are used as dependent variable measuring the quality of government. By adding interaction terms between school autonomy and the quality of government, I investigate how they work on the performance of students.

3. Empirical strategy

3.1. Conceptual framework

A variety of empirical models try to find what kind of factors affect the quality of education measured by students' test scores. Educational production function approach has been applied to the empirical models and extended to a wide range of empirical studies. A typical educational production function represents student outcomes (Edu) as a function of family inputs (F) and school inputs (S) :

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

Hanushek (1992) formulates the function considering family size and structure, the presence of father, and the time that parents spend with the students as family inputs and the interactions of teachers with students as school inputs. Hanushek (2003) extends his study by counting pupil-teacher ratio, academic background and experience of teachers, and amount of school's spending on education as school inputs. In the study of Wößmann (2003), school factors include more variables like shortage of materials, and instruction time. The empirical strategy of the study differs from that of the former studies in the way that it examines effects of school system (Inst) in educational production :

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

Hanushek (2013) follows the concepts focusing more on the role of school autonomy among the school system variables used in Wößmann (2003). He analyses how the local capacity of deciding academic contents, budget formulation, and personal management affects the achievement of students.

Here, however, I introduce an additional idea that the quality of education is affected by country-level institutional factors and the school system represented by autonomy interacts with them as mentioned in the earlier section. In this study, school autonomy is reclassified as school factor which is assumed as institutional factor in the previous studies and the proportion of school budget from government is also added. Instead, Country level institutional factors take variable 'Inst' in the equation (2) above.

3.2 Empirical model

To test the impact of institutions on the quality of education and its interaction with school system, I take the education production function framework described above and use fixed effect estimation. A linear formulation is introduced as following equation :

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

where Edu_{it} denotes the quality of education measured by achievement of students in country i at time t . $Inst_{it}$ measures the quality of institutions such as *democracy* (demo), *governance effectiveness* (goveff), and *control of corruption* (concorr). C_{it} is the vector of country factors like *the ratio of government expenditure on education* (govexp), and *log of GDP per capita* (lnGDP), which control the country level institutional factors. S_{it} stands for school factor such as *the proportion of school budget from government* (sbgov), *pupil-teacher ratio of secondary schools* (ptsec), *availability of teachers* (teachers), and *school autonomy over academic decisions* (autoacademic) and *over budget allocation decisions* (autobudget). Different from studies mentioned earlier, family factors are dropped because the effects of those factors are considered to be insignificant in the country-level estimation. Also, those are not what this study is interested in. μ_t denotes time fixed effects common to all countries, and μ_i denotes country-specific fixed effects which are time-invariant.

Equation (3) only investigates direct effects of institutions on the quality of education. So, 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 which are considered to be related to the quality of government institutions among school factors used in equation (3). Three variables from school factors such as the proportion of school budget from government, academic autonomy, and budget allocation autonomy are used to form the interaction term.

In this model, indirect effects of institutions as well as direct effects of institutions on the quality of education are examined. The interaction terms are generated for each

institutional factor. Through it, it can be analyzed what extent institutions affect education and which school factors become the channel of each institutions to influence the quality of education indirectly.

4. Data

The main dataset that this study depends on is from the Programme for International Student Assessment (PISA) which is an internationally standardized assessment conducted by the Organization for Economic Co-operation and Development (OECD). Targeting 15-year-old students in each country, the PISA tests a range of relevant skills and competencies. The subjects included in the test are mathematics, science, and reading.¹⁾ I combine variables from the results of 2000, 2003, 2006, 2009, and 2012 and merged them into one dataset. As the achievements of international students are only available from PISA, the sample countries are limited to those which participated in the assessments and time t's are limited to the periods that PISA test is conducted.²⁾

The dependent variable is measured by test scores of mathematics, science, and reading. I use weighted mean of the scores of those subjects. I give the largest weighted value to mathematics and the smallest weighted value to reading. There are other additional surveys to collect background information on each student and school. I use the questionnaires given to teachers to measure several school factors.

School autonomy is a key variable to be examined because it takes an important role in school system and also becomes the channel of country-level institutions to affect the quality of education. School autonomy refers to the degree that agents belong to each school do not depend on local/state government when they make a decision in operating their schools. I make use of two decision-making types. First, school autonomy over academic decisions comes from the questionnaires asked, "In your

¹⁾ Four assessments have been carried out in 2000, 2003, 2006, and 2009. 27 OECD countries and 16 non-OECD countries took part in the assessment in 2000. In 2003, 30 OECD countries and 10 non-OECD countries participated. 30 OECD countries and 27 non-OECD countries carried out the project in 2006. In 2009, 74 economies including 34 OECD countries carried out the program. More emerging economies are included than OECD countries in the latest assessment available. The assessment was carried out in 2012. However, the dataset would be available in December 2013, so the result in 2012 is not included in this study.

²⁾ PISA test is the only standardized test which makes it able to compare performance of students among a wide range of countries.

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 questionnaires, “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?” There are five tick boxes stated : not a school responsibility, appointed or elected board, principal, department head, and teachers. Except the item of ‘not a school responsibility’, others are the decision making agents belong to school system. To measure each types of school autonomy, I normalize the sum of responses of each tick boxes between 0 and 100. The normalized value of response of ‘not a school responsibility’ is subtracted from the total responses to leave pure value which represents autonomy.

Other school factors except pupil-teacher ratio also comes from additional surveys of PISA. The proportion of school budget from government is calculated from answers to the questionnaire asked, “About what percentage of your total funding for a typical school year comes from the following sources?” On the other hand, availability of math teachers is measured using questionnaire, “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 competitiveness of political participation, the openness and competitiveness of executive, and constraints on the chief executive. Governance effectiveness and control of corruption are obtained from governance indicator provided by World Bank. Governance effectiveness reflects perceptions of the quality of public and civil services, the degree of its independence from political pressures, and the quality of policy formulation. Control of corruption reflects perceptions of the extent to which public power is exercised for private gain, including both petty and grand forms of corruption, as well as capture of the state by elites and private interests. The degree of democracy is obtained from polity IV.

Table 1 summarizes descriptive statistics of variables used in the empirical model

and the source of data. The proportion of school budget from government (*sbgov*) ranges from 0 to 100. If a country has the maximum level of *sbgov*, it means budget source of average schools in the country perfectly depends on government. In terms of *teachers*, the average schools in the country suffer from the shortage of school teachers if the value reaches close to 0. *Autonomy over academic decision (autoacademic)* and

Table 1 Descriptive statistics

	obs.	mean	std.dev.	min	max	source
edu	265	462.04	56.21	311.9	553.9	PISA dataset
govexp	216	14.35	4.50	7.26	30.97	World Bank
lnGDP per capita	338	9.39	1.23	5.63	11.81	World Bank
sbgov	268	83.07	15.91	33	100	PISA dataset
ptsec	226	13.44	4.44	5.4	32.64	UNESCO
teachers	271	15.64	4.19	0	33.06	PISA dataset
academic autonomy	266	71.00	22.83	0	99.52	PISA dataset
budget autonomy	269	75.52	16.67	25.98	100	PISA dataset
democracy	315	8.07	3.04	0	10	Polity IV
governance effectiveness	340	0.84	0.84	-0.98	2.28	Governance Indicator World Bank Governance
control of corruption	343	0.70	1.03	-1.55	2.59	Indicator World Bank

Note : ‘Edu’ is the score of PISA test. The full names of each variable are as following. The ratio of government expenditure on education (*govexp*), the proportion of school budget from government (*sbgov*), pupil-teacher ratio of secondary school (*ptsec*), availability of teachers (*teachers*).

budget allocation (autobudget) ranges from 0 to 100. If the values of them are 0, it signifies that the average schools in the country don't have any rights to decide on academic contents or budget allocation at all but only depends on local and state government.

The democracy (demo) indicator is an additive eleven-point scale from 0 to 10. Governance effectiveness (goveff) and control of corruption range from -2.5 to 2.5, which the maximum level of the value means the country has strong governance performance. Correlation between explanatory variables is reported in table 2 below.

Table 2 Correlation between explanatory variables

	edu	govexp	lnGDP	sbgov	ptsec		
edu	1						
govexp	-0.2873	1					
lnGDP	0.6040	-0.2503	1				
sbgov	0.3647	-0.2794	0.3224	1			
ptsec	-0.2258	0.4628	-0.2476	-0.5001	1		
teachers	-0.2176	0.3818	-0.1255	-0.3284	0.3421		
autoacademic	0.4004	-0.0260	0.1308	-0.0256	0.2159		
autobudget	0.3553	0.0048	0.3131	-0.0047	0.1312		
demo	0.4935	-0.5050	0.3599	0.2451	-0.1523		
goveff	0.7270	-0.1061	0.8408	0.3792	-0.1585		
concorr	0.6405	-0.0908	0.8024	0.3799	-0.1466		
	teachers	autoacademic	autobudget	demo	goveff	concorr	
teachers	1						
autoacademic	-0.0936	1					
autobudget	0.0774	0.3572	1				
demo	-0.2072	0.3561	0.2998	1			
goveff	-0.1370	0.2800	0.4636	0.4105	1		
concorr	-0.0745	0.2615	0.4368	0.3915	0.9446	1	

5. Estimation results

5.1 Basic results

First, I investigate how the level of democracy affects the system of education and whether the selected school factors take a role as the channel for democracy to come into the quality of education. Table 3 shows the results of fixed effect estimation. Column (1) is the result of replication of the typical educational production function. In general, the ratio of government expenditure on education is not significant. The log of GDP per capita is positively significant. The proportion of school budget from government which is one of the factors that I assume to affect the performance of students is positive but not significant. Availability of teachers have positive sign but not significant. On the other hand, pupil-teacher ratio and academic autonomy are significant with negative signs. As PISA test is an internationally standardized assessment, the more decision power on what to teach and which textbooks to use is given to government, the higher score the students tend to get. So the negative sign of school autonomy over academic decisions makes sense. Column (2) represents the results with democracy without interaction terms. Democracy is reported to have strongly positive and significant coefficient. Higher the level of democracy each country has, better output it has. With other variables controlled, the proportion of school budget from government is still positive but insignificant. Other variables such as pupil-teacher ratio, availability of teachers, and academic autonomy keep the same results as column which is from the typical educational function.

To see if school system factors take roles as channels for democracy, each school system factors (the proportion of school budget from government, school autonomy over academic and budget decision) are multiplied by democracy to add interaction terms in column (3) to (5). In column (3), the interaction term between democracy and the proportion of school budget from government is negative and significant. That is, the proportion of school budget from government influences indirectly on educational system. In table 2, the correlation between the proportion of school budget from government and two school autonomy variables is negative. In other words, as the

Table 3 Results on democracy and the quality of education

	(1)	(2)	(3)	(4)	(5)
democracy (demo)		5.424***	17.263***	-1.815	-6.033
		1.587	5.973	7.497	6.687
the ratio of government	-1.280	-1.467	-1.188	-1.755	-1.042
expenditure on education	1.141	1.166	1.238	1.207	1.158
lnGDP per capita	16.178**	15.454**	15.022**	15.086**	14.752*
	7.840	7.359	7.096	7.261	7.562
the proportion of school	0.266	0.363	1.103***	0.373	-0.137
budget from gov. (sbgov)	0.234	0.242	0.267	0.258	0.401
pupil-teacher ratio	-2.172**	-2.120**	-1.578*	-2.151**	-1.602**
	0.996	0.853	0.952	0.852	0.781
availability of teachers	0.881	1.076	0.965	1.021	0.497
	0.670	0.696	0.757	0.687	0.791
academic autonomy	-0.253**	-0.219**	-0.222**	-0.971***	-0.238**
(autoacademic)	0.109	0.084	0.095	0.042	0.093
budget autonomy	0.006	-0.028	-0.015	-0.045	
(autobudget)	0.111	0.112	0.121	0.116	
demo*sbgov			-0.128*		
			0.067		
demo*autoacademic				0.078	
				0.085	
demo*autobudget					0.153*
					0.088
number of observations	103	101	101	101	101
number of groups	40	38	38	38	38

Notes : The dependent variable is the quality of education measured from the performance of PISA test. Because of the lack of data, in the wave of 2012, 2010 dataset is used for the ratio of government expenditure on education and 2011 dataset is used for the log of GDP. Robust standard errors in parentheses.

*p<0.1; **p<0.05; ***p<0.01

proportion of school budget from government increases, autonomy of school over operational decisions decreases. That is, increased financial support from government weakens the autonomy of schools. It explains that government uses its financial support for schools as a way to implement country-level educational policies efficiently and effectively. In that sense, uniformed policies and system which results high performance in a standardized assessment get harder to implement to each school if the level of democracy rises because democratic society pursues decentralized decision making and strengthens autonomy of school. So, if democracy level of a country goes up, the increased ratio of the proportion of school budget from government weakens the direct and positive effect of democracy itself on education. In column (5), the interaction term between democracy and budget autonomy is also significant with positive sign. As the level of democracy increases, the quality of education gets better if educational authorities give autonomy over budget formulation and decision of allocation to school board. Budget autonomy itself is not strongly related to the performance of students but it takes a role as a channel for institution to positively affect educational system.

Table 4 represents the second regression results of the relationship between governance effectiveness and the quality of education. In column (1), the direct effect of governance effectiveness on the quality of education is not remarkable. The proportion of school budget from government has positive but insignificant coefficient with other variables controlled. The quality of education gets better when the GDP per capita increases and the pupil-teacher ratio decreases. Autonomy over academic decision is still negatively significant.

In the case of examining interaction between governance effectiveness and the selected school factors, the only variable that is significant is the interaction term between government effectiveness and school autonomy over budget formulation and allocation decisions in column (5). That is, autonomy over budget allocation is a channel for government effectiveness to affect the quality of education. Contrary to the interaction between democracy and the proportion of school budget from government in

Table 4 Results on governance effectiveness and the quality of education

	(1)	(2)	(3)	(4)	(5)
governance effectiveness		9.510	32.785*	-6.584	-32.746*
(goveff)		6.141	19.157	13.731	17.623
the ratio of government	-1.280	-1.225	-1.157	-1.700	-1.249
expenditure on education	1.141	1.201	1.259	1.218	0.882
lnGDP per capita	16.178**	14.760*	17.762*	14.444*	9.004
	7.840	8.441	8.393	8.575	8.239
the proportion of school	0.266	0.291	0.191	0.290	-0.075
budget from gov. (sbgov)	0.234	0.230	0.276	0.230	0.252
	-2.172**	-2.159**	-1.710*	-2.162**	-1.835**
pupil-teacher ratio	0.996	0.930	0.999	0.900	0.783
	0.881	1.009	0.925	1.073	0.788
availability of teachers	0.670	0.685	0.729	0.685	0.628
academic autonomy	-0.253**	-0.237**	-0.242*	-0.367**	-0.247*
(autoacademic)	0.109	0.117	0.124	0.152	0.129
budget autonomy	0.006	-0.014	-0.001	-0.021	-0.314
(autobudget)	0.111	0.108	0.117	0.104	0.355
goveff*sbgov			-0.279		
			0.200		
goveff*autoacademic				0.188	
				0.147	
goveff*autobudget					0.530***
					0.183
number of observations	103	103	103	103	103
number of groups	40	40	40	40	40

Notes : The dependent variable is the quality of education measured from the performance of PISA test.

Because of the lack of data, in the wave of 2012, 2010 dataset is used for the ratio of government expenditure on education and 2011 dataset is used for the log of GDP. Robust standard errors in parentheses.

*p<0.1; **p<0.05; ***p<0.01

column (3) and (4), it works positively. When the quality of public services is improved and the education system becomes more independent from government, it creates a positive synergy effect on education.

Meanwhile, in column (3), the interaction between governance effectiveness and the proportion of school budget from government is negative as the result reported in table 3. Although it is not significant, the negative sign supports the idea that increasing school budget from government is not helpful to improve the education system when the level of governance effectiveness, which is an institutional factor, is raised.

Table 5 reports the regression between control of corruption and the quality of education. The results are similar to the regression between democracy and educational quality. In column (1) and (2), the log of GDP per capita is positively significant. The proportion of school budget from government has no direct influence on the performance of students. Pupil-teacher ratio is negatively significant. Academic autonomy is negatively significant regardless of whether interaction terms are added or not.

In the case of control of corruption, school autonomy over budget related decisions is a channel as the case of governance effectiveness as shown in column (5). When the capacity to monitor corrupted activities advances, it is more effective for government to give budget autonomy to school than to have financial power and try to affect school boards.

Another noticeable result is that control of corruption has no evidence to affect directly on the performance of students, which is different from the results that democracy and governance effectiveness have evidence that they affect education directly in table 3 and table 4. The way of control of corruption to work on political and economic system is different from that democracy and governance effectiveness. The higher level of democracy enables people to get more opportunities to learn. Students, their parents, or some educational institutions can raise the voice for improving the environment education and for the better educational quality. As their opinions can be reflected on establishing educational policies, development of democracy affects

education directly. Effective governance develops the quality of policies and public services. The improved governance effectiveness has an effect of extending in decentralized decision making process and policy formation. When the decision making process and formation policies are about educational issues, it also has a direct effect on the improvement of educational quality. However, control of corruption takes on a different character with democracy of governance effectiveness. The impact of control of corruption conflicts with institutional system. It rarely has a direct impact on social life of people such as education and health. Control of corruption causes dysfunctions of democracy (Della Porta and Vannucci, 1999). It also creates inefficiencies in deliveries of public services and formation of policies but by shifting public activities toward those sectors in which it is possible for those engaged in corruption exchanges to benefit (Warren, 2004). Corruption may affect education negatively through dysfunctions of democracy or making governance ineffective but it has no evidence to affect directly on the performance of students.

Table 5 Results on corruption and the quality of education

	(1)	(2)	(3)	(4)	(5)
control of corruption		12.544	31.823	-1.510	-23.518
(concorr)		7.573	22.973	13.916	18.293
the ratio of government	-1.280	-1.277	-1.177	-1.614	-1.228
expenditure on education	1.141	1.168	1.220	1.235	1.006
lnGDP per capita	16.178**	14.032*	13.595*	13.711	14.307**
	7.840	7.821	7.483	8.796	8.896
the proportion of school	0.266	0.257	0.097	0.260	0.003
budget from gov. (sbgov)	0.234	0.233	0.302	0.231	0.246
pupil-teacher ratio	-2.172**	-2.117**	-1.609	-2.187**	-1.837**
	0.996	0.929	1.040	0.926	0.811
availability of teachers	0.881	0.999	0.962	1.034	0.730
	0.670	0.714	0.730	0.712	0.727
academic autonomy	-0.253**	-0.257**	-0.263**	-0.305***	-0.256**
(autoacademic)	0.109	0.102	0.108	0.110	0.111
budget autonomy	0.006	-0.017	-0.156	-0.027	-0.113
(autobudget)	0.111	0.103	0.111	0.102	0.122
concorr*sbgov			-0.229		
			0.136		
concorr*autoacademic				0.142	
				0.112	
concorr*autobudget					0.435**
					0.170
number of observations	103	103	103	103	103
number of groups	40	40	40	40	40

Notes : The dependent variable is the quality of education measured from the performance of PISA test. Because of the lack of data, in the wave of 2012, 2010 dataset is used for the ratio of government expenditure on education and 2011 dataset is used for the log of GDP . Robust standard errors in parentheses.

*p<0.1; **p<0.05; ***p<0.01

5.2. Robustness test

The index used as dependent variable is weighted average of the scores of mathematics, science, and reading. So, several robustness tests are added to check the reliability of the models. As I choose each weight multiplied to the scores, so the additional test is essential to examine whether the result is robust when the weights are changed. In the regression of main results, each weighted value given to mathematics, science, and reading is 5/10, 4/10, and 1/10. Only the mathematics score is used in column (1)-(3), and in column (4)-(6), smaller weighted value than the previous analysis is given to mathematics and bigger weighted values are given to science and reading, but still the weight of mathematics is the biggest.

As shown in table 6, the result is similar to the results in the earlier section. When democracy is used as institutional variable in column (1) and (4), it still has a direct effect on the quality of education and negatively significant when it interacts with the proportion of school budget. The availability of teachers is still positively significant. Pupil-teacher ratio shows different results that it is negative as the basic results but not significant. Compared to column (5) in table 4, column (2) and (5) in table 6 whose institutional variable is governance effectiveness also shows same result. Pupil-teacher ratio and school autonomy over academic decision are negatively significant. The interaction term between governance effectiveness and school autonomy over budget related decisions is still positively significant. Column (3) and (6) is also similar to the main results. As the result in column (3) in table 5, academic autonomy and the interaction term between control of corruption and the proportion of school budget from government are negatively significant. The availability of teachers is positively significant only when the score of mathematics is used as dependent variable.

Table 6 Robustness test of dependent variable

	(1)	(2)	(3)	(4)	(5)	(6)
institutions	16.858***	-28.117	-19.614	19.228***	-35.526*	-24.212
	6.171	19.233	20.620	6.945	19.968	20.978
the ratio of government	-0.660	-0.757	-0.749	11.023	-0.644	-0.624
expenditure on education	1.192	0.894	1.021	8.479	0.959	1.131
lnGDP per capita	11.183	5.574	6.283	11.023	4.531	5.243
	7.872	9.018	9.542	8.479	9.897	10.601
the proportion of school	1.183***	0.029	0.107	1.339***	0.002	0.101
budget from gov. (sbgov)	0.267	0.284	0.280	0.306	0.313	0.308
pupil-teacher ratio	-1.858*	-2.161**	-2.177**	-1.876*	-2.205**	-2.226**
	1.020	0.886	0.929	1.103	1.001	1.045
availability of teachers	0.971	0.857	0.798	0.952	0.792	0.739
	0.807	0.699	0.791	0.905	0.750	0.867
academic autonomy	-0.249**	-0.267**	-0.278**	-0.284**	-0.308**	-0.317**
(autoacademic)	0.099	0.124	0.109	0.108	0.134	0.120
budget autonomy	0.024	-0.252	-0.064	0.001	-0.326	-0.103
(autobudget)	0.124	0.175	0.133	0.126	0.385	0.136
institutions*sbgov	-0.133*			-0.151*		
	0.069			0.078		
institutions*						
autoacademic						
institutions*autobudget		0.478**	0.371*		0.572***	0.444**
		0.202	0.193		0.210	0.202
number of observations	101	103	103	101	103	
number of groups	38	40	40	38	40	

Note: Dependent variable of column (1)-(3) is score of mathematics. In the case of column (4)-(6), smaller weighted value than the case of basic result is given when combining the dependent variable with the scores of science, mathematics, and reading. Institution variable is democracy in column (1) and (4), governance effectiveness in column (2) and (5), and control corruption in (3) and (6). Because of the lack of data, in the wave of 2012, 2010 dataset is used for the ratio of government expenditure on education and 2011 dataset is used for the log of GDP.

Robust standard errors in parentheses. *p<0.1; **p<0.05; ***p<0.01

6. Conclusion

In endogenous growth model, ideas and invention that human capital stock creates through activities such as research and development are the driving forces of economic growth (Romer, 1990). To raise the rate of growth rate, government tends to foster human capital that affects economy positively. It implements instructions and formulates policies to achieve its purpose to accumulate human capital stock, however, the vision of it can become pressure to schools which take a role as executive organs. The quality of school operating system differs according to what government pursues and to institutional quality.

Using the panel dataset from PISA, this paper investigates a channel through which government and institutions affect educational system. Fixed effects model is utilized. Educational production functions are set for each proxy for institutional quality such as democracy, governance effectiveness, and control of corruption. Interaction terms between some of school factors and institutional factors are included to investigate indirect influence of government and institutions on educational system.

This study finds that financial support from government and school autonomy over budget related decisions are the channel factors that this paper tries to investigate. According to the results, letting government have more power on deciding educational contents related policies acts as a positive role on students' performances, regardless of the level of institutions. However, implication in the case of financial problem is opposite. As the level of democracy and effective governance of societies increase, allowing schools to have autonomy to formulate school budget and decide the usage of it is better for performance of students than concentrating budget decision power on government.

Although this study has meaningful political implications, it has some limitations. Indices from the PISA dataset such as test scores, the proportion of school budget from government, academic autonomy, and budget autonomy are from simple averages of each country. However, educational policies that state or local government implicates could vary in different localities even in the same country. Each proxy of school factors

from the PISA dataset does not capture specific local differences of educational system. Also, as this paper uses the mean score of whole students, different influences of educational policies on a group of students in each percentile cannot be examined.

Further studies can be conducted as following. First, to recover the limitation which is mentioned above, the quantile regression method can be additionally utilized. There exists the dataset that indicates mean score of each quantile of distribution in PISA. Second, the quality of government and institutions and the effect of it vary in different development stages. The general criterion that divides development stage is GDP per capita. So, additional studies can be conducted for each development stage. I assume that in the initial stage, financial support from government with instructions would be effective to improve performance of students. On the other hand, giving autonomy schools to formulate and allocate school budget with relaxing empowerment from government would positively act on performance of students in developed society. The result of this study indicates that increased budget autonomy has positive influence as the society goes to democratic and governance effective society. The finding supports the assumption I suggest.

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요약

홍지은

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본 연구는 PISA 패널 데이터를 활용하여 정부와 제도의 질이 어떠한 채널을 통하여 교육 시스템에 영향을 미치는지 그 관계를 분석한다. 추정에는 고정 효과모형이 사용되었으며 민주주의 정도, 거버넌스 효과성, 그리고 부패 통제 수준이 제도의 질을 나타내는 변수로 도입되었다. 제도의 질이 교육시스템에 영향을 미치도록 하는 채널로는 정부의 양적 지원과 교육 과정, 예산 편성에 관하여 학교가 가지는 자율권을 가정했다. 분석결과, 교육과정 결정은 제도의 질과 상관없이 정부가 영향력을 가질수록 학생들의 성취도에 긍정적인 역할을 한다. 반면 민주주의 수준, 거버넌스 효과성 그리고 부패통제 수준이 높은 사회일수록 교육 정책에 대한 지침 수용을 조건부로 하는 정부의 재정적 지원을 줄이고 예산 편성과 사용 결정에 대한 자율권을 학교에 넘길 때 학생들의 성취도가 올라가는 것으로 나타난다.

주요어: 교육제도; 민주주의; 거버넌스 효과성; 부패; 학교 자율권

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