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Effectiveness of Government's Regulations on Private Teaching Institutes in Korea

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이 논문을 경제학 석사학위 논문으로 제출함.

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김설아의 경제학 석사학위 논문을 인준함.

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Abstract

Effectiveness of Government's Regulations on Private Teaching Institutes in Korea

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The education fever in Korea has no sign of slowing down as the competitiveness for going to renowned universities gets more important with the country's unemployment crisis. Due to an explosive demand for private education, regulation on private teaching institutes is critical in slowing down the overheated private education market drive in Korea. Some local governments have begun to set the constraint on operating hours of those institutes. With this movement, this paper analyzes the regulation effect on private education expenditures of Korean high school students using Tobit model as well as nonparametric model with the Youth Panel data from 2007 to 2010.

Patterns of private education expenditure are affected by gender, household income, parents' education attainment level, school type, and location. In addition to different factors of private education expenditure, regulation effects are different among regulated regions. In Panel Tobit estimation, Seoul has almost no effect of regulation while Busan's regulation effect is significant.

Furthermore, this paper conducts stochastic dominance test of Linton et al. (2010) and Barrett and Donald (2003). In testing stochastic dominance, regulation effects are shown different depending on the specification of a contact set between unregulated and regulated groups. Also, by conducting joint hypothesis test, I analyze whether the regulation has been effective consecutively every year since the regulation was implemented. Although the results are sensitive to specification of a contact set, they are consistent with Tobit estimation results.

Keywords : Private Education Expenditure, Regulation Effect,
Tobit Model, Stochastic Dominance, Bootstrap

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1 Introduction

The education fever in Korea has no sign of slowing down as the competitiveness for going to renowned universities gets more important with the country's unemployment crisis. Both students and parents are obsessed with going to renowned universities to be on the safe road for the future. The private education expenditures [1]and the private education market has been increasing every year, causing inequality problems in terms of education. Therefore, Due to an explosive demand for private education, Korean society is at a crossroad as to whether regulating private teaching institutes is effective in reducing the country's excessive education drive. A variety of ways to reduce the private education market have been devised from different aspects such as strengthening the public education's quality of education and promotion of taking EBS lectures to students. This paper especially analyzes the effect of regulating private teaching institutes with the limitation on operating hours.

The regulation of private teaching institutes is in fact controversial in that it hinders students' right to be educated as they want or it prevents excessive education fever as well as educational inequality among students. However, as the discussion over nationalization of regulation is going on, which is currently upon autonomy of provincial government, it is essential to clarify whether the regulation is actually effective.

Using the Youth Panel data from Korea Employment Information Service

[1]The private education should be distinguished from the concept of private institution's education. The term 'private education' refers to encompassing all the methods of students receiving education privately outside the school such as private tutoring and private teaching institutes.

from 2007 to 2010, this paper analyzes the impact of regulations on reducing private education expenditure. This paper firstly conducts Pooled OLS for estimation. Then, considering that the dependent variable (private education expenditures) has zero values, I apply random-effects Panel Tobit model.

In addition to parametric estimation, this paper newly implements the bootstrap methods of Linton. et al (2010) to test the stochastic dominance of two distributions with no control and with residuals. One of the two distributions is the distribution under no regulations, and the other is the one under the regulations. Especially I perform stochastic dominance test by regions: Seoul, Busan and Jeonbuk[2]. By figuring out the stochastic dominance between two distributions, the actual effects of those regulations can be evaluated along with the parametric estimation.

2 Literature Review

There have been numerous studies dealing with the private education throughout the world, which states that the private education and its market are not confined to Korea and its malicious aspects can be revealed in the future. Bray (2012) discussed about various policy measures in Asia with respect to private supplementary tutoring. Tansel (2006), Dang (2008), and Dawson (2010) mentioned about the supplementary tutoring in various areas such as Turkey and East Asia. However, the Korea's private education market is so overwhelming and exceptional that appropriate plans which alleviate these education fevers are to be quickly implemented.

[2]These regions are where the regulations are implemented during 2007-2010.

As sufficient measures to solve private education problems, there are some researches regarding Korea's regulation effects. Kim (2009) applies panel Tobit model for the data, which indicates that the regulations on the operating hours of private teaching institutes significantly decrease the monthly expenditure on private tutoring and weekly hours of private tutoring from 2005 to 2007. Kim and Chang (2010), on the other hand, focuses on the number of hours from governmental regulations for private teaching institutes. Moreover, Lee et al (2009) has shown the effect of policies by applying Tobit model and Heckman selection model with cross-sectional data. Analysis in this paper is different from previous studies in that it deals with the regional regulation effects since 2007 with new type of panel data.

Along with analyzing with Tobit model, I take into account the nonparametric estimation in the analysis. In fact, the goal of regulation on private teaching institutes does not only lie in lessening the swelling private education market, but its goal also is to narrow down the educational inequality, which can lead to economic polarization in the long run. As Choi (2012) noted, the income inequality and educational inequality are closely related especially in Korea. Thus, by applying Linton et al. (2010) and Barrett and Donald (2003), this paper implements the comparison of distributions before and after the regulation with respect to private education expenditure.

This paper also has uniqueness in that it uses Youth Panel data, which has not been used in previous studies. Also, while Kim (2009) analyzes the effect of governmental regulations during 2005-2007 period, this paper analyzes after 2007 until 2010, the time when the debate over regulating private teaching institutes becomes more than ever serious. The estimation comprises of 2007-2010 and excludes 2011 data because there are only 67 high students left in 2011 panel, which could trigger bias with other data sets on an estimation. In addition to the Tobit estimation, this paper newly conducts the stochastic dominance test without harnessing the sample's distributions.

3 Description of Data

3.1 Current Regulations on Private Teaching Institutes

The current regulations on private teaching institutes are different depending on the regions as the central government gave the provincial governments the autonomy to establish the ordinance at the province level.[3] The ordinance regulates two agents–private teaching institutes and study rooms (so called Dokseo-sil) regarding regulations on operating hours of private institutions. Our regions of interest are Seoul, Jeonlabukdo, and Busan, where the regulations were implemented during 2007-2010 as well as regulation time is either 10 PM or 11 PM.[4] In the analysis, even though the regulations are not implemented exactly from January of the year, the regulations are considered to be impledmented for a whole year[5].

3.2 Data

With respect to Korean educational data including private education sections, Korean Education and Employment Panel (KEEP data) from Korea

[3] The exact enactment date and the relevant details are shown in Table 1

[4] In the analysis, we excluded 24:00 PM regulation in the estimation

[5] However, since Jeonbuk implemented the regulation in December 2009, the regulation of Jeonbuk is only for 2010.

Research Institute for Vocational Education and Training and The Survey of Private Education Expenditures (SPEE) from Korea National Statistical Office are used in previous studies. These two data sets have strengths and weaknesses in analyzing the regulation effects respectively. Firstly, although SPEE data consists of a large number of samples each year, it is not a panel data, but a cross-sectional, which implies that it is not suitable for witnessing the regulation effects of students. Also, as SPEE data focus on the expenditures on private education expenditure with the specific elements such as subjects and a way of receiving private education, it does not contain household or school information, which are influential factors in private education expenditures. Secondly, regarding KEEP data, the panel data are not adequate for analyzing high school students during the period 2007-2010 since there are no subjects of analysis at the time of 2007 through 2010, although it was suitable for the research of Kim (2009) during the period 2005-2007.

For these reasons above, this paper uses Youth Panel data from Korea Employment Information Service. Youth Panel is a longitudinal survey that follows up the transition from school to work (equivalently from adolescence to adulthood), starting its second round of panel survey since 2007. The biggest advantage of this panel survey is that it contains abundant information about specific individual characteristics both of school and individual household. Moreover, the private education expenditures are categorized into many different standards such as subject, measure, and duration of receiving private education.

The data of our interest are of high school students during the period 2007-2010. Even though the regulation effects on private teaching institutes

Year	Number of Observations	Percent
2007	2,079	38.94
2008	1,677	31.41
2009	1,076	20.15
2010	507	9.50
Total	5,339	100

Table 1: Yearly Number of Observations in the Panel

among elementary as well as middle school students could be pivotal in some sense, I confine the analysis on high school students because competition for entrance exams is much more excessive compared to other groups and high school students are strongly affected by regulation on operating hours[6].

Since the private education expenditure values involve zero values, which means that there are some students receiving no private education because of the economic circumstances or other reasons, the analysis of regulation effect on private education expenditure is based on Tobit model which allows censored data. With the data used in this paper, the number of observations for each year is presented in Table 1.

In 2010, the number of students in the panel significantly reduces because Korean educational system for high school students is three years. The students in 2010 are middle school students in the beginning of the panel (2007).

[6]Most of high school students are at school because of mandatory self-study time after regular classes.

3.3 Variables

Variables used in the analysis are under the four categories: Individual, Household, School information, and Regulation information. Firstly, there are gender and grade as individual variables. If an individual is male, it is given as 1; otherwise, it is given as 0. Grades reflect the most recent exam results at school recorded by students and they are evaluated from 1 to 5 with five quantiles. If a student's grade is within upper 20 percent, it is recorded as 5, which gets the highest point.

Secondly, in household variables category, there are the number of siblings, father's education level, mother's education level, and average monthly income. Especially in measuring parents' education level, I integrated into four categories: lower than high school graduates, equal to high school graduates, equal to junior college graduates, equal or higher than university graduates. The higher number is given to the higher level of educational attainment. Also, in terms of the number of siblings, the numeric values become higher with more number of siblings. In case of being an only child, it is given as zero. The monthly income is an average of earned income, financial income, income from real estate and other income by taking logarithm, which is measured with units of 10,000 KSW.

Thirdly, regarding school variables, there are type of schools and school locations. The schools are divided into three types—general, specialized, and vocational. Specialized schools consist of foreign language high school, science school, and international school[7]. In vocational schools, agricultural high

[7] Here, international school is not the school for foreigners, but for Korean students.

school, technical high school, and commercial high school. Also, this paper applies school locations instead of household locations since there are few cases where students' residential location and their school location are different at the provincial level, especially among specialized school students. This happens because of the characteristic of specialized schools, which select students by entrance exams regardless of the regions where students belong although applying for those schools outside residential area is restricted for now. In those cases, school locations are much more important than residential locations. The school locations are reclassified as four categories—Seoul, Metropolitan Cities, Small and Medium-sized Cities, and Counties (Gun in Korea).

In the last category, regarding regulation information, there are regional dummies and regulation dummies. Regional dummies are Busan and Jeonbuk dummy[8]. Moreover, regulation dummies are constructed as an interaction term of year and region. As mentioned earlier, Seoul implemented 22:00 regulation in 2009 while Busan and Jeonlabukdo regions implemented 23:00 regulation in 2008 and 2010 respectively[9]. Most of other regions set up the ordinance with 24:00 regulations, but they are not included in the analysis.

Additionally, year dummies are included to reflect the country's economic circumstances and to compare the regulation effects among regions. These year dummies are important as Korea and other countries went through the financial crisis caused from subprime mortgage crisis in the United States in 2008. In the panel data, actually significant decrease from 2008 in overall

[8]Seoul dummy is omitted since it is already included in school's location category

[9]It means that private teaching institutes should close until 22:00 or 23:00.

distribution of private education expenditure is shown in Figure 1.

Dependent variable, private education expenditure, is monthly expenditure of all the subjects spending on private education measured by units of 10,000 KSW and it is taken logarithm. It is difficult to distinguish private education from private teaching institutes from other measures of private education since students can check multiple answers to what specific private education they receive. Thus, the private education expenditure is the total measure of private education such as private tutoring, not solely from private teaching institutes.

4 Parametric Estimation

4.1 Pooled OLS Estimation

With the panel data, I first conduct the pooled OLS estimation and the results are shown in Table 5. Concerning individual category, female students tend to receive more private education than male students. Also, students with having better grades at school participate in private education more than those who are not.

In the household category, as the number of siblings increase, the private education expenditure reduces. Regarding parents' education level, father's education level is more influential than mother's education level about 6 percent. Moreover, as we can easily expect, more income brings about more spending in private education.

Next, in the school information category, setting the criteria of location as

Seoul, the gap in private education expenditure between locations grow larger as the school location goes from Seoul to Metropolitan (Gwangyeok City), City and Gun area. In addition to school location, the difference with types of high school is conspicuous. Compared to general high school students, specialized school students tend to spend more in private education and vocational school students spend much less than general high school students. Higher spending in private education of specialized high school students comes from severe competition among students. On the contrary, vocational school students do not spend much in receiving education privately since the rate of going to universities among them is quite low compared to other two types of schools.

Lastly, the regulations of Seoul, Busan, and Jeonlabukdo are shown differently rather than regulating operating hours. Seoul's regulation on private teaching institutes is shown to rather increase the private education expenditure. This can be interpreted as the occurrence of transfer to other measures of private education as the private education expenditure allows all other measures of private education. Moreover, the effect of Busan's regulation is shown most effective than that of other regions in 2008 and 2010. The private education expenditure is reduced with the regulation, but the regulation effect is not statistically significant in 2009. In Jeonbuk region, the regulation is shown to reduce spending on private education, but it is not statistically significant.

4.2 Tobit Estimation

4.2.1 Model

Private education expenditures contain values equal or higher than zero. Because the dependent variable having zero values causes problems of inappropriate estimation for the analysis. Moreover, with Breusch-Pagan test, which rejected the null hypothesis, I now use the model considering the panel characteristics. Thus, Tobit model is used when the dependent variable is censored with the constraints on the dependent variable values.

Mostly, Tobit model is estimated with random effects, yet Honoré (1992) devised panel Tobit model. However, Honoré (1992) confines the panel of length at most 2, which cannot be used in our analysis (2007-2010).

The dependent variable is monthly private education expenditure on average, and I take the logarithm to the dependent variable. Also, to income and private education expenditure variable, it is re-calculated with household consumption GDP deflator. The panel Tobit model is represented as follows.

$$y_{it}^* = x_{it}'\beta + \epsilon_{it}, \qquad i = 1, ..., N \tag{1}$$

In the equation (1), y_i^* is latent variable for private education expenditure. In this model, x_{it} is the vector of factors which can influence on the private education expenditure, which are location, gender, household income, parent's education level, school type, grade, the number of siblings, Seoul regulation dummy, Busan regulation dummy, and Jeonlabukdo regulation dummy. β is the vector of parameter estimates of x_{it} and ϵ_{it} follows normal distribution with the zero average and its variance is σ^2. From the equation (2), the observed private education expenditure y_{it} are presented below.

$$y_i = \begin{cases} 0 & \text{if } y_i^* \leq 0 \\ y_i^\star & \text{if } y_i^\star > 0 \end{cases} \tag{2}$$

The notable point in calculation of $y_i^\star$ is that one is added all values of $y\_i^{\star 10}$. This is done in order to avoid zero values of $y\_i^\star$ become omitted by taking logarithm. Since y_i of value 1 becomes zero with taking logarithm, it does not make any difference in the estimation. Different from general maximum likelihood estimation, Tobit model acquires likelihood function by combining the total sample with censored and uncensored data. Log-likelihood function for Tobit model is as follows[11].

$$ln\ L = \sum_{y_i>0} -\frac{1}{2}\left[log(2\pi) + ln\ \sigma^2 + \frac{(y_i - x'_i\beta)^2}{\sigma^2}\right] + \sum_{y_i=0} ln\left[1 - \Phi\left(\frac{x'_i\beta}{\sigma}\right)\right]$$

Based on this model, estimation results are shown in Table 6.

4.2.2 Estimation Results

The results of Tobit estimation are explained with the variables categories of individual, household, school and regulation information. First, regarding individual variables, female students tend to receive private education more than male students. Also, as students have worse grades, they are receiving less private education than those getting better grades.

[10]Then, $y_i = 0$ if $y_i^* \leq 1$, and $y_i = y_i^\star$ if $y_i^\star > 1$

[11]Greene (2011)

With respect to household variables, I would first explain with the parents' education attainment level. While both father's education level and mother's education level are shown as positively significant to the private education expenditure, father's education level has more impact on the private education level compared to mother's education level. Moreover, with the increase in the number of siblings, private education expenditure decreases. More importantly, as the income and expenditure has positive correlations each other, the private education expenditure goes up with the rise in household income.

Now let's discuss about the school effect on the private education expenditure. Among city-level regions, Seoul has the highest average private education expenditures. Average expenditures on private education differ depending on the size of those cities. In other words, bigger the city is, more private education expenditures are spent. Especially, as counties (Gun regions) have much lower expenditure on private education, the difference between Seoul region and Counties is the largest among that with other regions. Also, regarding school type, specialized schools spend more on private education because those schools (Science high school, foreign language high school, etc.) are more competitive. On the other hand, considering the fact that vocational schools focus more on getting a job after graduation rather than going to college, students at vocational schools spend much less on private education.

Most importantly, now my analysis of interest is about the regulation effect on the private education expenditure and the regional difference rather than regulation time difference is shown to be more influential in private education spending. In case of Seoul, private education expenditures increase with the regulation. One interpretation of this result is that the transfer to other measures of private education occurred instead of receiving private education at private education institutes. However, there has been regulation effect in Busan. The regulation effect in 2010 is the biggest, followed by that of 2008 and that of 2009. Even though regulation effect of 2009 is not statistically significant with Pooled OLS estimation, all regulation effects of Busan are statistically significant, contributing to reducing the private education expenditures. Lastly, in Jeonbuk region, although the coefficient of Jeonbuk's regulation in 2010 shows reduction in private education expenditures, it is not statistically significant. Despite the difference in regions, this provides critical implications that regulation on private teaching institutes plays a pivotal role in reducing private education expenditure.

4.2.3 Marginal Effects of Regulation

Once estimating with Tobit model, marginal effects are to be calculated to figure out the regulation effects. Table 7 presents marginal effects of all variables, but I will focus on regulation dummies' marginal effects.

According to Table 7, Impact of regulation on private teaching institutes is minimal. Rather, private education expenditures of Seoul in 2009 and 2010 increased. Except Seoul, Busan and Jeonbuk regions are shown to have regulation effects of reducing private education expenditure. Despite the difference of reduced amount of expenditure, significant reduction in private education expenditures is noticed. However, in Jeonbuk region, slight fall in spending private education is resulted, yet it is not statistically significant.

5 Nonparametric Estimation: Testing Stochastic Dominance

Following the Tobit model estimation, now I analyze the regulation effect on private education expenditure with the nonparametric estimation of first-order and second-order stochastic dominance by using the bootstrap method of Linton et al. (2010) and Barrett and Donald (2003). This method is pivotal in that it is possible to measure the regulation effect by comparing distributions of two groups–regulated regions and unregulated regions; or regulated year and unregulated year. Furthermore, this paper shows the results of stochastic dominance test with joint hypothesis to figure out the regulation effects consecutively after implementing the regulation.

5.1 Test statistic and Bootstrap Methods

Since two sample sizes are not equivalent, I use the modified test statistic of Linton et al. (2010) as follows.[12] M is the sample size of X_0 and N is the sample size of X_1.

$$T_N \equiv \int_{\chi} \max\left\{\sqrt{\frac{MN}{M+N}}\bar{D}_{01}(x), 0\right\}^2 w(x)\mathrm{d}x \tag{3}$$

$$\begin{aligned} \textit{where} \quad & \bar{D}_{01}^{(1)}(x,\theta,\tau) \equiv \bar{F}_0(x) - \bar{F}_1(x) \\ & \bar{D}_{01}^{(2)}(x,\theta,\tau) \equiv \textstyle\int_{-\infty}^{x} \bar{D}_0(t,\theta,\tau)\mathrm{d}t - \int_{-\infty}^{x} \bar{D}_1(t,\theta,\tau)\mathrm{d}t \end{aligned}$$

[12]Barrett and Donald (2010) proposed a consistent test of stochastic dominance when the sample sizes of comparing groups are different.

$\bar{D}_{01}$ refers to the difference between CDF of X_0 and X_1 when testing first-order stochastic dominance. When testing the second-order stochastic dominance, $\bar{D}_{01}^{(2)}$ is used as presented above. The weight function $w(x)$ is analyzed with two forms: $w(x) = 1\{x \leq \mu\}$ and $w(x) = 1$.

The hypotheses are presented below, and $D_{01}(x)$ is different according to which order of stochastic dominance is tested.

$$
\begin{aligned}
&H_0 : D_{01}(x) \leqq 0 \quad \text{for all} \quad x \in \chi, \\
&H_1 : D_{01}(x) > 0 \quad \text{for some } x \in \chi
\end{aligned}
$$

In testing stochastic dominance, I also conduct the test under the null hypothesis, which is the opposite direction of null hypothesis suggested above. That is, $H_0 : D_{01}(x) \geq 0 \quad \text{for all } x \in \chi$. This is done in order to clarify the stochastic dominance since it is uncertain about the stochastic dominance when the null hypothesis is not rejected. To conduct inferences from the limiting distribution, bootstrap method is used in this paper. First I assume that θ_0 and τ_0 are identified through a moment condition: $\mathbb{E}[Z_i \varphi_k(W;\theta,\tau)] = 0, \quad k = 0, 1$. The bootstrap test statistic is also a modified test statistic, which comes from the different sample sizes of X_0 and X_1.

$$
T^*_{N,b} \equiv \begin{cases} \int_{\hat{B}} \max\left\{\sqrt{\frac{MN}{M+N}}\bar{D}^*_{01}(x), 0\right\}^2 w(x)\mathrm{d}x & \text{if} \int_{\hat{B}} w(x)\mathrm{d}x > 0 \\ \int_{\chi} \max\left\{\sqrt{\frac{MN}{M+N}}\bar{D}^*_{01}(x), 0\right\}^2 w(x)\mathrm{d}x & \text{if} \int_{\hat{B}} w(x)\mathrm{d}x = 0 \end{cases}
$$

$$
\textit{where} \quad \bar{D}^*_{01,b}(x) = \tilde{D}^*_{01,b} - \bar{D}_{01}
$$

In determining the contact set $\hat{B} \equiv = \{x \in \chi : | \bar{D}_{01}(x) | < c_K\}$, where$c_K$[13] is a sequence that $c_K \to 0$ and $c_K\sqrt{K} \to \infty$, I propose a simple suggestion to choose appropriate values of c: $\frac{1}{B}\sum_{b=1}^{B} \bar{D}_{01,b}(x) \lesssim c < \max|\bar{D}_{01,b}(x)|$. When c is much less than the mean of $\bar{D}_{01,b}(x)$, the contact set becomes so narrow that $\hat{B} \approx 0$. When c becomes closer to $\max|\bar{D}_{01,b}(x)|$, p-values become larger under the null hypothesis. Throughout this paper, the tests of stochastic dominance for each case is done with this rule of determining the value of c.

5.2 Monte Carlo Experiment

Before testing the stochastic dominance with empirical example, I first conduct Monte Carlo Experiment to verify this stochastic dominance methodology regarding using the bootstrap methods for censored distribution, especially in first-order stochastic dominance test. I assume that $X_k(\theta, \tau) = \varphi_k(W; \theta, \tau)$. Then, the data generating process is presented as follows.

Let U_k be U[0,1] random variables.

$$X_k(\theta, \tau) \equiv | 1\{U_k < P_k\} \times N(\mu_{k1}, \sigma_{k1}^2) | + | 1\{P_k < U_k\} \times N(\mu_{k2}, \sigma_{k2}^2) |,$$

$$where \;\; k = 0, 1 \;\; \text{and} \;\; 0 < P_k < 1$$

As the private education expenditure is always equal or higher than zero value and its distribution mimics mixed Gaussian distribution, I design the experiment with data generated from folded mixed normal distributions.

Under this design scheme, four different cases are simulated. The first case is least favorable case (LFC) where two samples are generated with identical

[13] K simply means $\frac{MN}{M+N}$

	X_0			X_1		
	P_0	(μ_{01}, σ_{01})	(μ_{02}, σ_{02})	P_1	(μ_{11}, σ_{11})	(μ_{12}, σ_{12})
Case 1	0.5	(0 , 10)	(25, 80)	0.5	(0 , 10)	(25, 80)
Case 2	0.5	(0 , 10)	(25, 80)	0.5	(0 , 10)	(25, 70)
Case 3	0.5	(0 , 10)	(25, 80)	0.5	(0 , 10)	(20, 60)
Case 4	0.7	(0 , 5)	(20, 60)	0.5	(0 , 10)	(25, 80)

Table 2: Data Generating Process

distribution. The second case is partially dominating case by keeping μ_{11}, σ_{11}^2, and P_k levels while changing the value of σ_{12}^2. The third case is also a partially dominating case by setting the values of μ_{11}, σ_{11}^2 and μ_{12}, σ_{12}^2 respectively while maintaining the P_1 level identical to that of $X_1(\theta, \tau)$. The fourth case is a strictly dominating case of F_1 where both $\mu_{11}, \sigma_{11}^2, \mu_{12}, \sigma_{12}^2$ and P_1 values are set differently. This is the case where the null hypothesis is invalid.

Each specification of experiment is presented in Table 1. In simulations, I simply set M=N for each case and conduct an experiment for N=100 and N=1000. The number of Monte Carlo simulations was 1000 and the number of bootstrap replications was 500. Moreover, only uniformly weighted function is used in the experiment and the value of c is {2.0 2.5 3.0}.

Table 8 shows rejection probabilities of Monte Carlo Experiments. In Case 1, the rejection probabilities are similar to the nominal level. As the contact set goes more into the null hypothesis, the rejection probability converges to zero. In Case 2 and Case 3, the rejection probabilities are slightly under rejection or over rejection. But, the rejection probabilities for Case 3 is lower than those of Case 2 as can be expected from the data generating process. Lastly, in Case 4, as the null hypothesis is invalid, the rejection probabilities when N=100 are almost close to 1 while they all converge to 1 when N=1000.

5.3 Test Results of Stochastic Dominance

Tests of Stochastic Dominance are conducted with first-order and second-order dominance. Then, for stochastic dominance of each order, the dominance of distribution of private education expenditure under no regulation over distribution under regulation is tested with no control and with residuals. Especially in testing first-order stochastic dominance, I conduct the test of joint hypothesis by applying the similar method of getting the test statistic.

5.3.1 Stochastic Dominance with No Control

In this section, without controlling any other variable, I test the stochastic dominance with nominal private education expenditure values.

First-Order Stochastic Dominance The CDFs of each comparing groups are shown in Figure 2. The first comparing group is Pooled sample with no regulation versus regulated sample. The second is Seoul's CDF between 2008 (before regulation) and 2010 (after regulation) as Seoul imposed regulation in 2009. The third group is Busan's private education expenditure between 2007 and 2009 because Busan region implemented the regulation in 2008. The last group is samples of Jeonbuk between 2009 and 2010, which reflects the regulation of Jeonbuk area in 2010.

Along with CDFs of each group, Figure 3 presents difference in CDFs of each group. As one might expect from Figure 2, Seoul region shows a single crossing, which shows wide variation in difference in CDF. Also, in Jeonbuk region, as multiple crossings in CDF occur, it reflects wider variation in difference of CDFs. In other cases, the differences are shown all under zero.

The results of first-order stochastic dominance testing in Table 11 and 12. For each group (Pooled, Seoul, Busan, and Jeonbuk), the number of bootstrap tests is 500 for each case. Furthermore, as the value of c influences the size of a contact set ($\hat{B}$), different values of c are chosen based on the sample sizes of each case. With the appropriate choices of c, as the c increases, which implies that the increasing size of a contact set, the p-values also rise when the null hypothesis is true.

First, in cases where $w(x) = 1\{x \leq \mu\}$, the null hypotheses for all cases except Jeonbuk are not rejected with different p-values in Table 10. In Pooled case, judging from the results that the null is not rejected in Table 11 and rejected in Table 12[14], it is compatible to state that regulation has been effective in a pooled sample. However, in case of Seoul, none of the null hypotheses is rejected, which implies that there is weak stochastic dominance[15] in this region. This corresponds to the Tobit estimation result that the regulation has not been effective. Moreover, as the value of c increases, p-values become lower in Seoul.

P-values of Busan is the highest among the presented cases in Table 11 and they are all zeros in Table 12. As with Pooled case, from these two tests, the regulation on private teaching institutes are shown effective. In Jeonbuk region, the results of first-order stochastic dominance testing are quite different with the weight functional forms. With weight function 1

[14]In Table 12 (Test 2), the hypotheses are as follows. $H_0 : D_{01}(x) \geq 0 \; for \; all \; x \in \chi$; $H_1 : D_{01}(x) < 0 \; for \; some \; x \in \chi$. The null of Test 1 and Test 2 are opposite direction in testing stochastic dominance

[15]Weak dominance refers to a situation when the null hypothesis of Test 1 and Test are both not rejected, which implies that $F_0 \backsimeq F_1$

($w(x) = 1\{x \leq \mu\}$), the null hypothesis is rejected in both tests of Table 11 and 12. In this case, it is uncertain that which group dominates the other, giving ambiguous conclusion about the regulation effect. On the other hand, with the weight function $w(x) = 1$, both null hypotheses are not rejected, so that this can be said that there exists weak stochastic dominance in Jeonbuk area, implying that regulation effects are minimal or none.

Overall, the p-values are generally higher where the weight function is $w(x) = 1$ than the other case ($w(x) = 1\{x \leq \mu\}$) in Table 11 even though the reverse results are shown in Table 12. This means that stochastic dominance of overall private education expenditure under regulation is more explicitly shown than that of private education expenditure below median. In all cases where $w(x) = 1$, except Seoul, p-values of all three other cases are almost 1, while the p-values are quite different among these cases. Especially in Seoul, p-values are lower in $w(x) = 1$ functional form since a single crossing in CDF occurs (When applying the weight function $w(x) = 1\{x \leq \mu\}$).

As a result of first-order stochastic dominance test 1 and 2, it can be concluded that unregulated group stochastically dominates the regulated group for Pooled and Busan case. In Seoul, each group (unregulated and regulated) weakly dominates each other while it is obscure whether any group stochastically dominates the other in Jeonbuk region.

Second-Order Stochastic Dominance In addition to testing first-order stochastic dominance, now I test second-order stochastic dominance in a similar manner. The justification of testing second-order dominance comes from the results of first-order stochastic dominance that the p-values lie between

0.01 and 0.05[16]. As in first-order stochastic dominance test, the weight function has two forms: $w(x) = 1$ and $w(x) = 1\{x \leq \mu\}$. The test results are shown in Table 13 and 14[17].

The results of second-order stochastic are almost similar to those of first-order stochastic dominance. Pooled and Busan cases have shown that the regulation is effective in reducing the private education expenditure from the compatible results of Test 1 and Test 2. The noticeable point in this testing is regarding Seoul and Jeonbuk region. In the previous first-order SD test, it is shown that there is only weak dominance between two comparing groups in Seoul. However, the regulation is shown as ineffective at the 10% level when the value of c is 8 and the values are uniformly weighted, as can be easily implied by Table 13 and 14. Moreover, in Jeonbuk, the results of second-order stochastic dominance tests are quite striking in that they show opposite results depending on the weight functional form. When testing with $w(x) = 1\{x \leq \mu\}$, both tests in Table 13 and 14 are rejected, which can be said that it is again uncertain about the existence of dominance. On other other hand, with $w(x) = 1$, both tests are not rejected, implying that each group weakly dominates each other.

5.3.2 Residual Dominance

Testing stochastic dominance directly with the single index can be dangerous since it ignores economic situations such as depression or economic boom and

[16]This is because the first-order stochastic dominance implies the second-order stochastic dominance, but the reverse is not true.

[17]Similarly, in Table 14 (Test 2), the hypotheses are given as follows. $H_0 : D_{01}(x) \geq 0 \; for \; all \; x \in \chi$; $H_1 : D_{01}(x) < 0 \; for \; some \; x \in \chi$. The null of Test 1 and Test 2 are opposite direction in testing stochastic dominance

other potential factors affecting private education expenditure. If a country went through a severe economic depression during 2007 and 2010, the private education expenditure might have lessened automatically. Therefore, although real values of private education expenditures are reflected in the previous analysis, dominance testing with residuals based on the results of Pooled OLS estimation is performed in this section by controlling those factors. Although it might be more appropriate to estimate with Tobit estimation results, it is not applicable to test stochastic dominance due to its nonlinear aspect. As shown in parametric estimation section, Pooled OLS estimation results are mostly statistically significant, thereby residuals after Pooled OLS are used in this section by controlling year effects and all other factors introduced in parametric estimation. As one might expect, the results are quite different from the previous analysis.

First-Order Stochastic Dominance Before discussing the test results, the CDFs of each group are in Figure 4. For each case, Pooled OLS estimation is performed with the dependent variable, the log of total private education expenditures. Then, for those residuals, they are divided into regulated and unregulated categories and then analyzed with the same method of test with no control. As seen from Figure 4, there are multiple crossings in CDFs, which is different from 5.3.1. Thus, it implies that test results can change even without the consideration of weight functional forms.

The results of first-order stochastic dominance of residuals are presented in Table 11 and 12. The noteworthy point in these tests is that the results show differently according to the form of a weight function. First, in Pooled case, while the regulation is shown as effective with the use of weight function $w(x) = 1\{x \leq \mu\}$ from the compatible p-values of Test 1 and Test 2, it is uncertain about the dominance with the use of uniformly weighted function since both null hypotheses are rejected. This difference in results is also revealed in Seoul region. With WF 1, it can be concluded that the regulation is effective although no dominance is found in other cases of Seoul region at 5% level. From this result, the regulation is effective among the private education spending under median while its effect is ambiguous with all expenditures on private education.

In addition to Seoul, the test results of Busan's regulation are not only distinct with the difference in weight functions but also with the previous analysis (stochastic dominance with no control). When applying WF1, the regulation is found effective at the 5 % level by comparing the results of Table 11 and Table 12. However, with WF 2, even though Busan region's regulation has shown effective in both weight functional forms in section 5.3.1, the effectiveness of regulation is unclear in all tested values of c as both tested hypotheses are rejected. As the estimation results are very sensitive to the value of c, the results of stochastic dominance test show differently in Jeonbuk region as well. Under the setting that c takes 0.1, there exists regulation effect in Jeonbuk region for both weight functions at the 10 percent level and 5 percent level respectively. Other than that, there is weak stochastic dominance in Jeonbuk region from two tests.

Second-Order Stochastic Dominance The CDFs are depicted in Figure 6 and the test results are in Table 13 and 14. After controlling potential factors to private education expenditures, the effectiveness of regulation in each case is evaluated differently with the case with no control. First, regarding Pooled case, while the regulation is shown effective under WF 1, there is weak dominance with WF 2. This result is different from that of stochastic dominance with no control. Likewise, Seoul's stochastic dominance test of regulation is similar to Pooled case. Under the weight function $1\{x \leq \mu\}$, the results of Table 13 and Table 14 imply that the regulation is effective. However, under WF 2, each comparing group weakly dominates the other in Seoul.

In particular, Busan region's results are noticeable in that the effectiveness of regulation in that different results are drawn compared to stochastic doimnance test with no control. In the previous section, although the regulation is shown effective in all weight functional forms, it is only effective with WF 1 at 5 percent level for 0.7 and 1.0 values of c and at 1 percent level when c is 0.5. Lastly, in Jeonbuk region, when c takes 0.1 and the weight function is $1\{x \leq \mu\}$, regulated group stochastically dominates unregulated group, which implies the regulation is not effective. Except that specification, weak stochastic dominance is shown in Jeonbuk region.

5.3.3 Joint Hypothesis Testing

In testing joint hypothesis testing, its goal is to test whether the regulation is effective consecutively throughout the regulated years. For instance, when Busan implemented the regulation in 2008, this joint hypothesis enables testing the regulation effects both in 2008 and 2009 compared to 2007 (before regulation). The hypotheses and presented below.

$$H_0 = F_0(x) \leqq F_1(x) \;\; \& \;\; F_0(x) \leqq F_2(x) \; for \; all \quad x \in \chi$$
$$H_1 = F_0(x) > F_1(x) \;\; \& \;\; F_0(x) > F_2(x) \; for \; some \; x \in \chi$$

The alternative can be $H_2 : F_0 > F_1 \;\; or \;\; F_0 > F_2$, but this joint test is to figure out the simultaneous effectiveness of regulation, I test with the above alternative hypothesis. In addition, this joint test is performed with different null hypothesis to obtain compatible results about the regulation effects, as presented below.

$$H_0 : F_0(x) \geqq F_1(x) \;\; \& \;\; F_0(x) \geqq F_2(x) \; for \; all \; x \in \chi$$
$$H_1 : F_0(x) < F_1(x) \;\; \& \;\; F_0(x) < F_2(x) \; for \; some \; x \in \chi.$$

Despite its complicated form of test statistic for joint test, the test statistic is quite similar to previous analysis as proposed as follows.

$$T_N \equiv \max \left\{ \int_\chi \max \left\{ \sqrt{K} \bar{D}_{01}(x), 0 \right\}^2 w(x) \mathrm{d}x, \int_\chi \max \left\{ \sqrt{O} \bar{D}_{02}(x), 0 \right\}^2 w(x) \mathrm{d}x \right\}$$
$$where \; K = MN/(M+N), \; and \; O = MQ/(M+Q)$$

In case of first-order dominance, $\bar{D}_{01}(x) = \bar{F}_0 - \bar{F}_1$, and $\bar{D}_{02}(x) = \bar{F}_0 - \bar{F}_2$. Also, M,N, and Q refers to the sample size of $X_0, X_1, and X_2$ respectively. As bootstrap statistic and estimating methods are almost identical to previous sections and proposed statistic, it is omitted in this paper. However, when using bootstrap methods, in order not to make covariance greater or less than zero, it is important to construct the test statistic with the same X_0^* to obtain $\bar{D}_{01}(x)$ and $\bar{D}_{02}(x)$.

In testing the joint hypothesis, as with previous analysis, the tests of stochastic dominance are conducted with no control and with residuals and only first-order stochastic dominance test is conducted. Figure 7 and Figure 8 show CDF of comparing years for each case.

Seoul Region Since Seoul imposed regulation on private teaching institutes in 2009, the dominance test is done through 2008 to 2010 (2008 vs. 2009 and 2008 vs. 2010). The results are in Table 15 and Table 16. The stochastic dominance in Seoul differs according to the weight function. First, in testing stochastic dominance with no control, while each group weakly dominates each other with WF 1, the results of regulation effects are different with uniformly weighted function along with the specification of value c. When taking c1=0.05 and c2=0.10, as the null of Test 1 is rejected and the null of Test 2 is not rejected, the regulation is ineffective under this specification. However, except that case with uniformly weighted function, Seoul's regulation on private teaching institutes is shown as effective.

However, the results of testing stochastic dominance with residuals are almost opposite to those with no control. With the weight function using median, the regulation is effective except the case where c1=0.05 and c2=0.15. In case where c1=0.05 and c2=0.15, the stochastic dominance is obscure between two comparing groups. On the other hand, the regulation effect is uncertain in Seoul region's comparing groups with uniformly weighted function.

Busan Region As mentioned above as an example, the comparing years are 2007 to 2009 (Thus, when testing the stochastic dominance, 2007 vs. 2008 and 2007 vs. 2009). Likewise, the results are in Table 15 and Table 16. Under joint hypotheses, regardless of the forms of a weight function, the regulation is effective for all specifications of value c (the size of a contact set) in both tests of stochastic dominance with no control as well as with residuals. Therefore, even though each year's comparison of regulation effects in Busan varies as seen in the previous sections, the regulation has been effective after implementing the regulation policy in 2008 from the results of Table 15 and Table 16.

While Seoul's regulation effects are difficult to state in that the effectiveness of regulation is different depending on the specification of the size of a contact set, Busan's regulation on private teaching institutes can be said as effective in reducing private education expenditure with the compatible results of Test 1 and Test 2 for SD test with no control as well as SD test with residuals.

6 Conclusion

As private education market has been expanding in Korea, various measures at the government level involve the regulation on private teaching institutes as well as strengthening the curriculum at school. Among them, the regulation on private teaching institutes is quite controversial because it can be argued as hindering the right to be educated as students want while it is interpreted as an attempt to alleviate the education inequality. In particular, this paper analyzes whether the direct regulation on private teaching institute's operation time is effective in reducing the country's excessive education drive.

Although the regulated regions are four regions during 2007-2010 period, currently there are seven regions regulating private teaching institutes at 22:00 and 23:00 as shown in Table 2. As the governmental regulation is currently being issued with the national implementation of regulation, this paper has critical impact in that it has shown whether regulation is significantly effective in reducing private education expenditures . By applying the Tobit model with random effects, the regulation effects are shown as different from region to region. In Busan, the effect of regulation is statistically significant in reducing private education expenditures although the regulation in Seoul is minimal or rather increases the private education expenditure. In Jeonbuk, reduction of private education expenditure is shown, but it is not statistically significant.

In addition to parametric estimation of panel Tobit model, first-order and second-order stochastic dominance testing is introduced for the nonparametric analysis. This is pivotal and significant in that it allows comparing the distributions of private education expenditure as it is. In particular, bootstrap method of Linton et al. (2010) and Barrett and Donald (2003) is used in figuring out the stochastic dominance between regulated and unregulated groups. According to the estimation results, the regulation of private teaching institutes is shown effective especially in Busan while its effect is differently shown in other regions under each specification.

In conclusion, although there are numerous measures for policy makers in alleviating the education inequality with the explosive private education market, regulation on private teaching institutes with their operating hours can be conducive to alleviate the problem. In the sense that this regulation could surely slow down the explosive demand for private education for going to colleges, resulting in less education inequality for students as well as prevention of more economic polarization coming from education inequality.

References

Barrett, G; Donald, S. 2003. Consistent Tests for Stochastic Dominance. *Econometrica*. Vol. 71, No. 1, pp. 71-104

Bray TM; Lykins, CR. 2012. Shadow Education: Private Supplementary Tutoring and its Implications for Policy Makers in Asia. *Metro Manila, Philippines: Asian Development Bank*

Choi, J.S. 2012. Private Tutoring and Educational Inequality: Evidence from a Dynamic Model of Academic Achievement in Korea. Presented at *Population Association of America Annual Meeting.*

Dang, Hai-Anh; Rogers, F. Hasley. 2008. How to Interpret the Growing Phenomenon of Private Tutoring: Human Capital Deepening, Inequality Increasing, or Waste of Resources? *World Bank*

Dawson, Walter. 2010. Private Tutoring and Mass Schooling in East Asia: Reflections of Inequality in Japan, South Korea, and Cambodia. *Education Research Institute, Seoul National University*

Greene, W.H. 2011. Econometric Analysis. *Pearson Education* 7th Ed.

Honoré, Bo E. 1992. Trimmed Lad and Least Squares Estimation of Truncated and Censored Regression Models with Fixed Effects. *Econometrica*. Vol. 60. No. 3. pp 533-565

Kim, Ji-Ha. 2009. The Effectiveness of Regulation for Cram Schools on Demand for Private Tutoring. *The Journal of Educational Administration.* Vol. 27. No. 4. pp 465-487

Kim, Ji-Ha; Chang, Jihyun. 2010. Do Governmental Regulations for Cram Schools Decrease the Number of Hours Students Spend on Private Tutoring? *KEDI Journal of Educational Policy* Vol. 7 No. 1

Lee, J.et al 2009. Consumption pattern of private tutoring and an analysis of the effect of policies for reducing private tutoring expenses: Application of Tobit model and Heckman selection model. *Korean education*, 36(2), pp 189-221

Linton, O; Song, K; Whang, W-J. 2010. An Improved Bootstrap Test of Stochastic Dominance. *Journal of Econometrics* Vol. 154, Issue 2, pp 186-202

Tansel, Aysit; Bircan, Fatma. 2006. Private Tutoring Expenditures in Turkey. *Economics of Education Review*, 25(3), 303-313.

Appendix A: Tables

Region	Enforcement of Ordinance	Regulation Time
Seoul	Sep. 2009	22:00
Gwangju	Nov. 2010	22:00
Kyunggido	Mar. 2011	22:00
Daegu	Mar. 2011	22:00
Busan	Apr. 2008	23:00
Jeonlabukdo	Aug. 2009	23:00
Incheon	Oct. 2011	23:00
Jeonlanamdo	Nov. 2007	23:50
Chungcheongbukdo	Sep. 2007	24:00
Kyungsangnamdo	Dec. 2007	24:00
Ulsan	Oct. 2008	24:00
Jeju	Jan. 2011	24:00
Daejeon	Feb. 2012	24:00
Kyungsangbukdo	Feb. 2012	24:00
Chungcheongnamdo	Mar. 2012	24:00
Gangwondo	Mar. 2012	24:00

Table 3: Ordinance on Private Teaching Institutes

Note: This is based on Act on the Establishment and Operation of Private Teaching Institutes and Extracurricular Lessons, Article 6-(2) Act No. 8711, Dec. 21, 2007. The regulation time applies to high school students. In some regions, the provincial government sets up different regulation time on private teaching institutes depending on the students' level–elementary, middle, and high school.

Variable	Sample	Mean	Std. Dev.	Min	Max
Gender	5339	1.4781	0.4995	1	2
Grade	5339	3.4126	0.9393	1	5
Siblings	5339	1.2697	0.6566	0	6
Father's Edu. Level	5339	2.6858	1.0259	1	4
Mother's Edu. Level	5339	2.3337	0.8756	1	4
Income	5339	5.6722	0.5109	2.3786	7.4191
Location: Seoul	5339	0.1947	0.3960	0	1
Location: Metropolitan	5339	0.4210	0.4937	0	1
Location: City	5339	0.3483	0.4765	0	1
Location: Other	5339	0.0357	0.1857	0	1
School Type: General	5339	0.7797	0.4144	0	1
School Type: Specialized	5339	0.0207	0.1426	0	1
School Type: Vocational	5339	0.1994	0.3996	0	1
Busan	5339	0.1146	0.3186	0	1
Jeonbuk	5339	0.0301	0.1710	0	1
Year dummy: 2007	5339	0.3893	0.4876	0	1
Year dummy: 2008	5339	0.3141	0.4642	0	1
Year dummy: 2009	5339	0.2015	0.4011	0	1
Year dummy: 2010	5339	0.0949	0.2931	0	1
Reg. Seoul_09	5339	0.0337	0.1805	0	1
Reg. Seoul_10	5339	0.0179	0.1328	0	1
Reg. Busan_08	5339	0.0367	0.1880	0	1
Reg. Busan_09	5339	0.0235	0.1518	0	1
Reg. Busan_10	5339	0.0097	0.0982	0	1
Reg. Jeonbuk_10	5339	0.0037	0.0610	0	1
Private Edu. Expenditure	5339	2.2612	1.8516	0	5638

Table 4: Descriptive Statistics

Note: Male students are given zero in Gender variable, and female students are given one. The values of grade are evaluated according to five quantiles. Income is monthly household income with unit 10,000 KRW and is taken logarithm. Parents' education level is evaluated with four levels.

Variable	Coefficient	Std. Err.	t	$P >\mid t \mid$
Female	0.0943	0.0418	2.25	0.024
Grade	0.1278	0.0223	5.72	0.000
Siblings	-0.1462	0.0320	-4.56	0.000
Father's Edu Level	0.1576	0.0262	6.02	0.000
Mother's Edu Level	0.0947	0.0302	3.13	0.002
Income	0.6074	0.0442	13.72	0.000
Loc_2	-0.3716	0.0690	-5.38	0.000
Loc_3	-0.3556	0.0675	-5.26	0.000
Loc_4	-0.9310	0.1266	-7.35	0.000
Type_2	0.2902	0.1467	1.98	0.048
Type_3	-1.0668	0.0547	-19.47	0.000
Busan	0.0678	0.1092	0.62	0.534
Jeonbuk	-0.3950	0.1328	-2.97	0.003
Reg. Seoul_09	0.3669	0.1400	2.62	0.009
Reg. Seoul_10	0.3292	0.1859	1.77	0.077
Reg. Busan_08	-0.4148	0.1552	-2.67	0.008
Reg. Busan_09	-0.1756	0.1795	-0.98	0.328
Reg. Busan_10	-0.4333	0.2489	-1.74	0.082
Reg. Jeonbuk_10	0.0335	0.3721	0.09	0.928
dum. 2008	-1.3279	0.0528	-25.12	0.000
dum. 2009	-1.5892	0.0666	-23.83	0.000
dum. 2010	-1.7381	0.0909	-19.12	0.000
Constant	-0.6921	0.2614	-2.65	0.008

Table 5: Pooled OLS Estimation Results

Note: Busan and Jeonbuk dummies are included in order to estimate the regulation effects of Busan, Jeonbuk, and Seoul region (Seoul dummy is Loc_1 dummy, but it is omitted in the estimation due to multicollinearity problem with Loc_2, Loc_3, and Loc_4). Each regulation dummy is an interaction term of regulating year and regional dummy.

Variable	Coefficient	Std. Err.	z	P $>\mid z \mid$
Female	0.1878	0.0750	2.50	0.012
Grade	0.1763	0.0369	4.77	0.000
Siblings	-0.2555	0.0598	-4.27	0.000
Father's Edu Level	0.2484	0.0465	5.34	0.000
Mother's Edu Level	0.1151	0.0534	2.16	0.031
Income	0.8390	0.0776	10.80	0.000
Loc_2	-0.4531	0.1142	-3.97	0.000
Loc_3	-0.4625	0.1117	-4.14	0.000
Loc_4	-1.3555	0.2337	-5.80	0.000
Type_2	0.3163	0.2502	1.26	0.206
Type_3	-1.8400	0.1037	-17.73	0.000
Busan	0.1787	0.1652	1.08	0.279
Jeonbuk	-0.5270	0.2383	-2.21	0.027
Reg. Seoul _09	0.6612	0.2010	3.29	0.001
Reg. Seoul_10	0.5423	0.2789	1.94	0.052
Reg. Busan_08	-0.8574	0.2261	-3.79	0.000
Reg. Busan_09	-0.4573	0.2753	-1.66	0.097
Reg. Busan_10	-1.2735	0.4375	-2.91	0.004
Reg. Jeonbuk_10	-0.0643	0.6087	-0.11	0.916
dum. 2008	-1.9567	0.0752	-26.00	0.000
dum. 2009	-2.4709	0.1002	-24.66	0.000
dum. 2010	-2.7959	0.1450	-19.28	0.000
Constant	-2.3018	0.4584	-5.02	0.000
sigma_u	1.2160	0.0456	26.63	0.000
sigma_e	1.8650	0.0319	58.29	0.000

Table 6: Panel Tobit Model Results

Note: As in Pooled OLS estimation, Busan and Jeonbuk dummies are included in order to estimate the regulation effects of Busan, Jeonbuk, and Seoul region (Seoul dummy is Loc_1 dummy, but it is omitted in the estimation due to multicollinearity problem with Loc_2, Loc_3, and Loc_4). Each regulation dummy is an interaction term of regulating year and regional dummy.

Variable	Delta-method dy/dx	Std. Err.	z	P>| z |	[95% CI]	
Gen_2*	0.1436	0.0574	2.50	0.012	0.0311	0.2562
Grade	0.1347	0.0282	4.77	0.000	0.0794	0.1900
Siblings	-0.1952	0.0457	-4.27	0.000	-0.2849	-0.1056
Father's Edu	0.1898	0.3556	5.34	0.000	0.1201	0.2595
Mother's Edu	0.0880	0.0408	2.16	0.031	0.0080	0.1680
Income	0.6412	0.0593	10.81	0.000	0.5249	0.7275
Loc_2*	-0.3438	0.0860	-4.00	0.000	-0.5125	-0.1751
Loc_3*	-0.3487	0.0831	-4.20	0.000	-0.5116	-0.1858
Loc_4*	-0.9037	0.1310	-6.89	0.000	-1.1606	-0.6468
Type_2*	0.2481	0.2012	1.23	0.217	-0.1462	0.6425
Type_3*	-1.2452	0.0601	-20.70	0.000	-1.3632	-1.1273
Busan*	0.1382	0.1293	1.07	0.285	-0.1152	0.3918
Jeonbuk*	-0.3838	0.1645	-2.33	0.020	-0.7062	-0.0613
Reg. Seoul _09*	0.5315	0.1688	3.15	0.002	0.2005	0.8625
Reg. Seoul_10*	0.4329	0.2315	1.87	0.061	-0.0207	0.8867
Reg. Busan_08*	-0.6043	0.1449	-4.17	0.000	-0.8884	-0.3202
Reg. Busan_09*	-0.3351	0.1926	-1.74	0.082	-0.7127	0.0424
Reg. Busan_10*	-0.8504	0.2462	-3.45	0.001	-1.3331	-0.3677
Reg. Jeonbuk_10*	-0.0488	0.4598	-0.11	0.915	-0.9501	0.8523
dum. 2008*	-1.3798	0.0477	-28.89	0.000	-1.4734	-1.2862
dum. 2009 *	-1.5918	0.0513	-30.99	0.000	-1.6925	-1.4911
dum. 2010*	-1.6177	0.0559	-28.90	0.000	-1.7274	-1.5080

Table 7: Marginal Effects from Panel Tobit Estimation

Note: Marginal effects are calculated in order to estimate the actual effectiveness of regulations after panel tobit estimation. With variables marked with star (*), dy/dx is for discrete change of dummy variable from 0 to 1.

DGP	Value of c	α-level (N=100)			α-level (N=1000)		
		0.01	0.05	0.10	0.01	0.05	0.10
Case 1	2.0	0.009	0.045	0.092	0.015	0.050	0.079
	2.5	0.007	0.046	0.106	0.015	0.044	0.096
	3.0	0.003	0.043	0.099	0.017	0.070	0.121
Case 2	2.0	0.006	0.038	0.094	0.006	0.023	0.094
	2.5	0.018	0.057	0.112	0.006	0.034	0.068
	3.0	0.006	0.047	0.084	0.018	0.050	0.095
Case 3	2.0	0.012	0.029	0.078	0.015	0.068	0.111
	2.5	0.005	0.032	0.075	0.008	0.050	0.119
	3.0	0.008	0.041	0.079	0.007	0.037	0.091
Case 4	2.0	0.922	0.994	0.999	1.000	1.000	1.000
	2.5	0.915	0.978	0.992	1.000	1.000	1.000
	3.0	0.916	0.991	0.999	1.000	1.000	1.000

Table 8: Results from Monte Carlo Simulations

Note: The table presents rejection probabilities under the null hypothesis. The Monte Carlo Experiments are done for 1000 times. The weight function used in this experiment is $w(x) = 1$. Critical values are computed after bootstrapping 500 times. α level is the significance level and the value of c determines the size of a contact set.

Case		Sample	Mean	Std. Dev.	Median
Pooled	No Reg.	4669	30.0791	34.8433	22
	Reg.	344	31.5698	36.3207	30
Seoul	No Reg.	344	31.5698	36.3207	30
	Reg.	96	36.6771	43.0516	30
Busan	No Reg.	238	34.0630	32.8359	25
	Reg.	126	12.0714	19.7732	0
Jeonbuk	No Reg.	34	8.8235	16.4325	0
	Reg.	20	8.3500	16.8500	0

Table 9: Descriptive Statistics of Each Comparing Group

Note: Pooled case is combined regulated group and unregulated group. In Seoul's case, regulated group is from 2010 and unregulated group is from 2008. Likewise, Busan's regulated group is in 2009 while its unregulated group is from 2007. Lastly, Jeonbuk's comparing years are 2009 and 2010.

Case		Sample	Mean	Std. Dev.	Median
Pooled	No Reg.	4669	-0.0061	1.4923	0.2358
	Reg.	670	0.0140	1.6488	-0.1782
Seoul	No Reg.	764	-0.0129	1.4555	0.3473
	Reg.	276	0.0000	1.7293	0.5946
Busan	No Reg.	238	0.0035	1.2795	0.3169
	Reg.	374	0.0000	1.5361	-0.4842
Jeonbuk	No Reg.	141	-0.0093	1.3445	-0.2193
	Reg.	20	0.0000	1.4638	-0.6133

Table 10: Descriptive Statistics of Residuals

Note: Likewise, each comparing group is identical to that of Table 10. Residuals are obtained from conducting Pooled OLS estimation. Except Pooled case (Case 1), Pooled OLS is conducted without location dummies (Loc_2, Loc_3, Loc_4, Busan, and Jeonbuk) and regulation dummies (Since I divide the residuals depending on the existence of regulation).

Case	No Control			Residual Dominance		
	c	WF 1	WF 2	c	WF 1	WF 2
Pooled	3.0	0.640	0.990	0.5	0.304	0.000
	3.5	0.642	0.994	0.7	0.308	0.002
	4.0	0.656	0.990	1.0	0.310	0.006
Seoul	2.0	0.500	0.116	0.3	0.256	0.000
	2.5	0.492	0.114	0.5	0.380	0.002
	3.0	0.476	0.090	0.7	0.400	0.016
Busan	3.0	0.700	0.972	0.5	0.052	0.000
	3.5	0.726	0.980	0.7	0.052	0.000
	4.0	0.694	0.972	1.0	0.068	0.000
Jeonbuk	0.01	0.000	0.258	0.1	0.198	0.056
	0.02	0.000	0.296	0.3	0.308	0.296
	0.05	0.000	0.450	0.5	0.322	0.308

Table 11: First-Order Stochastic Dominance (Test 1)

Note: This table shows p-values from the results of first-order stochastic dominance test under $H_0 :\ F_0 \leqq F_1 \ \ for\ all\ x$, with no control and residuals respectively. The tests are conducted with different values of c and weight functions. WF1 refers to $w(x) = 1\{x \leq \mu\}$, and WF 2 refers to $w(x) = 1$. The value of c determines the size of a contact set ($c_N = cN^{-1}log(log(N))$). The number of bootstrap is 500.

Case	No Control			Residual Dominance		
	c	WF 1	WF 2	c	WF 1	WF 2
Pooled	3.0	0.000	0.000	0.5	0.000	0.000
	3.5	0.000	0.000	0.7	0.000	0.002
	4.0	0.000	0.000	1.0	0.000	0.008
Seoul	2.0	0.216	0.636	0.3	0.002	0.000
	2.5	0.234	0.622	0.5	0.004	0.004
	3.0	0.208	0.592	0.7	0.022	0.016
Busan	3.0	0.000	0.000	0.5	0.000	0.000
	3.5	0.000	0.000	0.7	0.000	0.000
	4.0	0.000	0.000	1.0	0.000	0.000
Jeonbuk	0.01	0.000	0.254	0.1	0.078	0.020
	0.02	0.000	0.328	0.3	0.176	0.226
	0.05	0.000	0.458	0.5	0.166	0.260

Table 12: First-Order Stochastic Dominance (Test 2)

Note: Different from Table 12 (Test 1), this table shows p-values from the results of first-order stochastic dominance test under $H_0: \ F_0 \geqq F_1 \ \ for\ all\ x$, with no control and residuals respectively. The tests are conducted with different values of c and weight functions. WF1 refers to $w(x) = 1\left\{x \leq \mu\right\}$, and WF 2 refers to $w(x) = 1$. The value of c determines the size of a contact set ($c_N = cN^{-1}log(log(N))$). The number of bootstrap is 500.

Case	No Control			Residual Dominance		
	c	WF 1	WF 2	c	WF 1	WF 2
Pooled	40	0.520	0.196	0.5	0.254	0.450
	45	0.584	0.254	0.7	0.262	0.430
	50	0.548	0.654	1.0	0.268	0.438
Seoul	8.0	0.490	0.084	0.5	0.432	0.524
	9.0	0.522	0.104	0.7	0.434	0.542
	10.0	0.526	0.106	1.0	0.442	0.550
Busan	30	0.540	0.220	0.5	0.026	0.342
	35	0.566	0.236	0.7	0.072	0.374
	40	0.570	0.248	1.0	0.084	0.414
Jeonbuk	1.0	0.000	0.574	0.1	0.000	0.438
	2.0	0.000	0.602	0.3	0.174	0.476
	5.0	0.000	0.618	0.5	0.196	0.478

Table 13: Second-Order Stochastic Dominance (Test 1)

Note: This table shows p-values from the results of second-order stochastic dominance test under $H_0: \ D_0 \leqq D_1 \ \ for\ all\ x$, with no control and residuals respectively. $D_0 = \int_{-\infty}^{x} F_0 \mathrm{d}x$ and $D_1 = \int_{-\infty}^{x} F_1 \mathrm{d}x$ The number of bootstrap is 500. WF1 refers to $w(x) = 1\{x \leq \mu\}$, and WF 2 refers to $w(x) = 1$. The value of c determines the size of a contact set ($c_N = cN^{-1}log(log(N))$).

Case	No Control			Residual Dominance		
	c	WF 1	WF 2	c	WF 1	WF 2
Pooled	40	0.000	0.000	0.5	0.000	0.192
	45	0.000	0.000	0.7	0.004	0.184
	50	0.000	0.000	1.0	0.006	0.154
Seoul	8.0	0.190	0.562	0.5	0.000	0.198
	9.0	0.212	0.518	0.7	0.000	0.208
	10.0	0.208	0.588	1.0	0.002	0.200
Busan	30	0.000	0.000	0.5	0.044	0.116
	35	0.000	0.000	0.7	0.114	0.112
	40	0.000	0.000	1.0	0.120	0.120
Jeonbuk	1.0	0.000	0.480	0.1	0.334	0.418
	2.0	0.000	0.510	0.3	0.690	0.464
	5.0	0.000	0.484	0.5	0.668	0.470

Table 14: Second-Order Stochastic Dominance (Test 2)

Note: In Test 2 of second-order stochastic dominance, the null hypothesis is different from Test 1 of Table 14. This table shows p-values from the results of second-order stochastic dominance test under $H_0: \ D_0 \geqq D_1 \ \ for\ all\ x$, with no control and residuals respectively. $D_0 = \int_{-\infty}^{x} F_0 \mathrm{d}x$ and $D_1 = \int_{-\infty}^{x} F_1 \mathrm{d}x$ The number of bootstrap is 500. WF1 refers to $w(x) = 1\{x \leq \mu\}$, and WF 2 refers to $w(x) = 1$. The value of c determines the size of a contact set ($c_N = cN^{-1}log(log(N))$).

Case	Value of c		Weight Function $w(x) = 1\{x \leq \mu\}$		$w(x) = 1$	
	c1	c2	Test 1	Test 2	Test 1	Test 2
Busan	0.1	0.1	0.830	0.000	0.652	0.000
	0.2	0.2	0.834	0.000	0.774	0.000
	0.5	0.5	0.842	0.000	0.892	0.000
Seoul	0.05	0.10	0.242	0.240	0.032	0.052
	0.07	0.12	0.258	0.290	0.054	0.038
	0.10	0.15	0.290	0.398	0.062	0.042

Table 15: Joint Hypothesis: First-Order Stochastic Dominance with No Control

Note: This table shows p-values after conducting FOSD test with residuals. In case of Busan when $w(x) = 1\{x \leq \mu\}$, I integrated over large X instead of contact set $\hat{B}$ (because $\hat{B}$ is an empty set for that case). The number of bootstrap is 500.

Case	Value of c		Weight Function $w(x) = 1\{x \leq \mu\}$		$w(x) = 1$	
	c1	c2	Test 1	Test 2	Test 1	Test 2
Busan	0.5	0.5	0.924	0.000	0.984	0.000
	0.7	0.7	0.940	0.000	0.992	0.000
	1.0	1.0	0.950	0.000	0.996	0.002
Seoul	0.01	0.10	0.682	0.006	0.806	0.154
	0.02	0.12	0.702	0.096	0.822	0.150
	0.05	0.15	0.796	0.174	0.846	0.274

Table 16: Joint Hypothesis: First-Order Stochastic Dominance with Residuals

Note: This table shows p-values after conducting FOSD test with residuals. The number of bootstrap is 500.

Appendix B: Figures

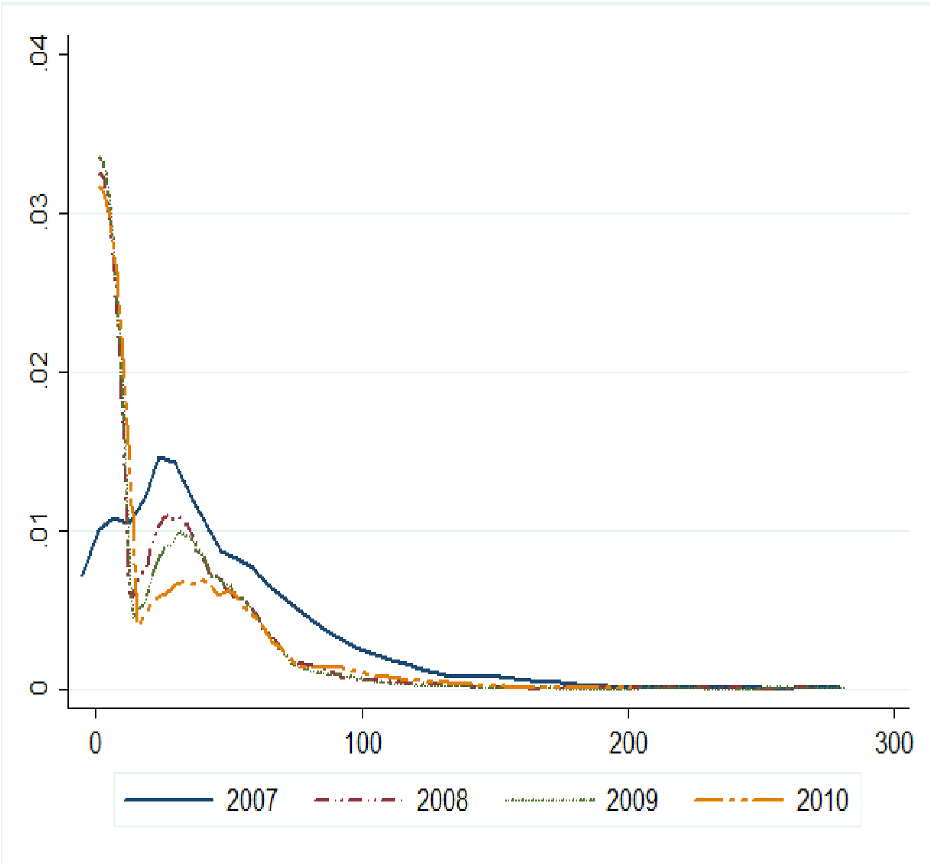
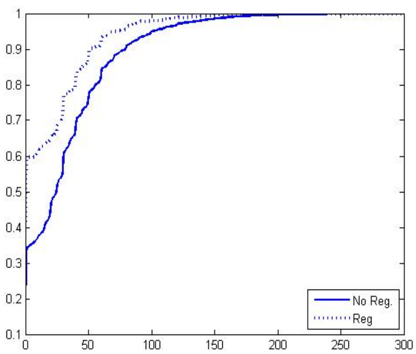
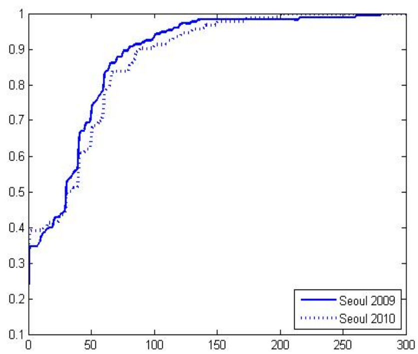


Figure 1: Kernel Density of Private Education Expenditure

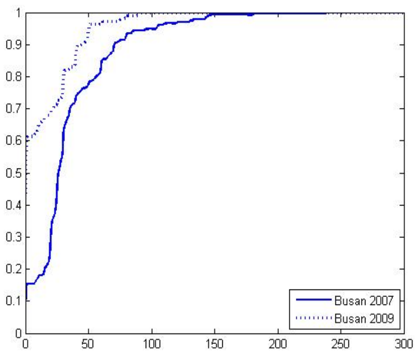
Note: This figure shows yearly distribution of private education expenditure. Since 2008, possibly due to the impact of economic recession triggered by subprime mortgage crisis of the United States, overall private education expenditures significantly reduced compared to 2007.



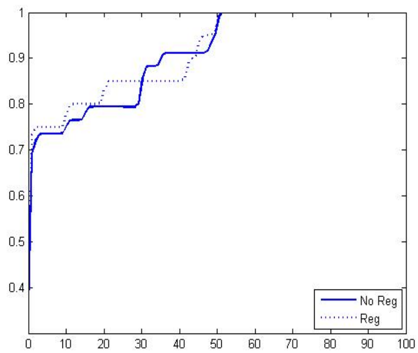
(a) Pooled CDFs



(b) CDFs of Seoul



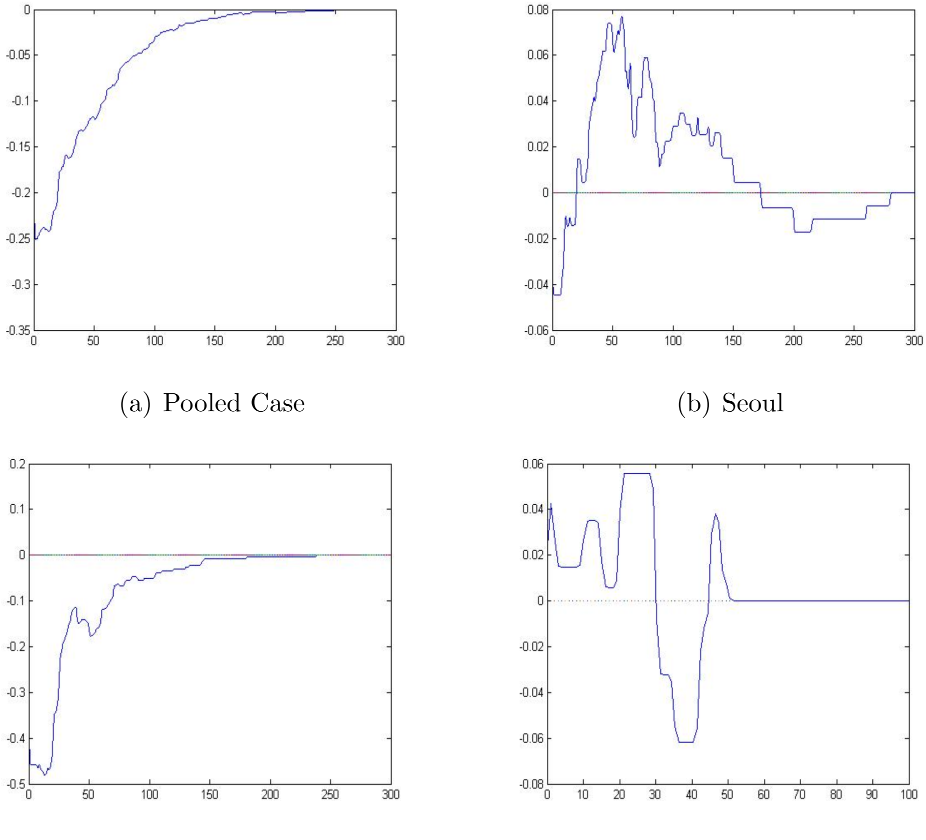
(c) CDFs of Busan



(d) CDFs of Jeonbuk

Figure 2: Empirical CDFs of Private Education Expenditure

Note: The figures above are empirical CDF of each case. Seoul implemented the regulation in 2009 while Busan did in 2008 and Jeonbuk did in 2010.

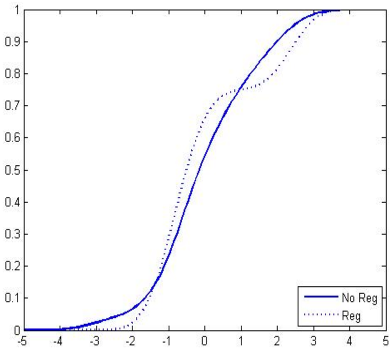


(a) Pooled Case (b) Seoul

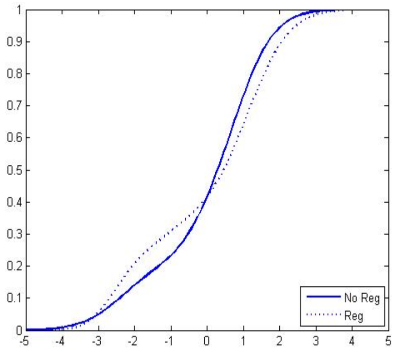
(c) Busan (d) Jeonbuk

Figure 3: Difference in CDFs

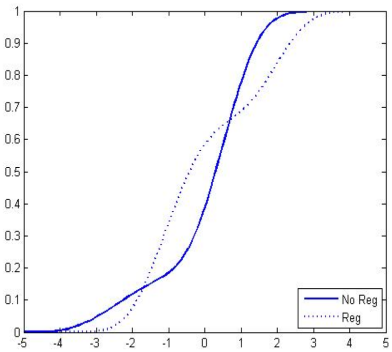
Note: The figures above are difference in CDFs with respect to private education expenditure. As quickly imagined from the empirical CDFs, the difference is calculated by $F_0 - F_1$ (CDF with no regulation - CDF with regulation). Seoul region shows a single crossing in CDF, which shows wide variation. Also, in Jeonbuk region, as multiple crossings in CDF occur, it reflects wider variation in difference of CDFs. The difference of CDFs in other cases is shown all under zero.



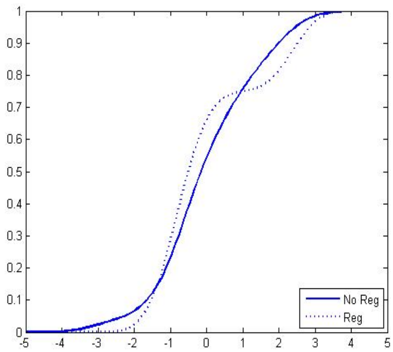
(a) Pooled Case



(b) Seoul



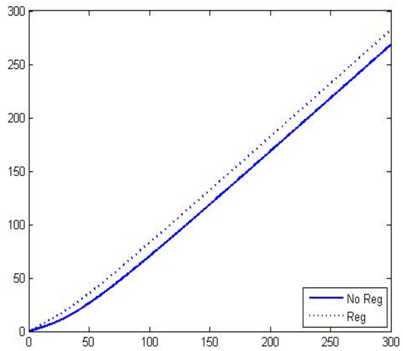
(c) Busan



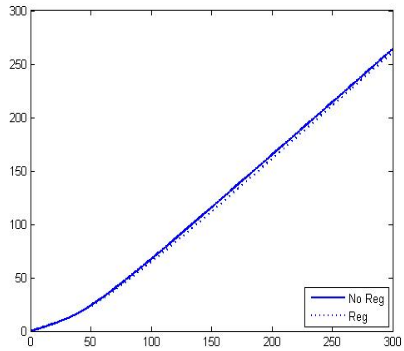
(d) Jeonbuk

Figure 4: CDFs of Residuals from Pooled OLS Estimation

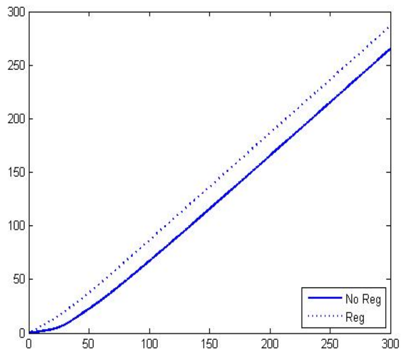
Note: Each figure shows CDF of residuals from Pooled OLS estimation. This is for testing first-order stochastic dominance. In pooled case, comparing groups are whether there is regulation or not. Comparing years of Seoul region is 2008 (before regulation) and 2010 (after regulation), and Busan's comparing years are 2007 (before regulation) and 2009 (after regulation). In case of Jeonbuk, 2009 and 2010 are comparing years of regulation.



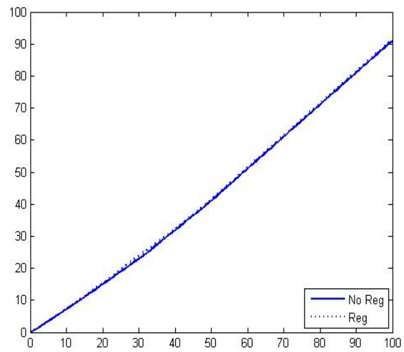
(a) Pooled



(b) Seoul



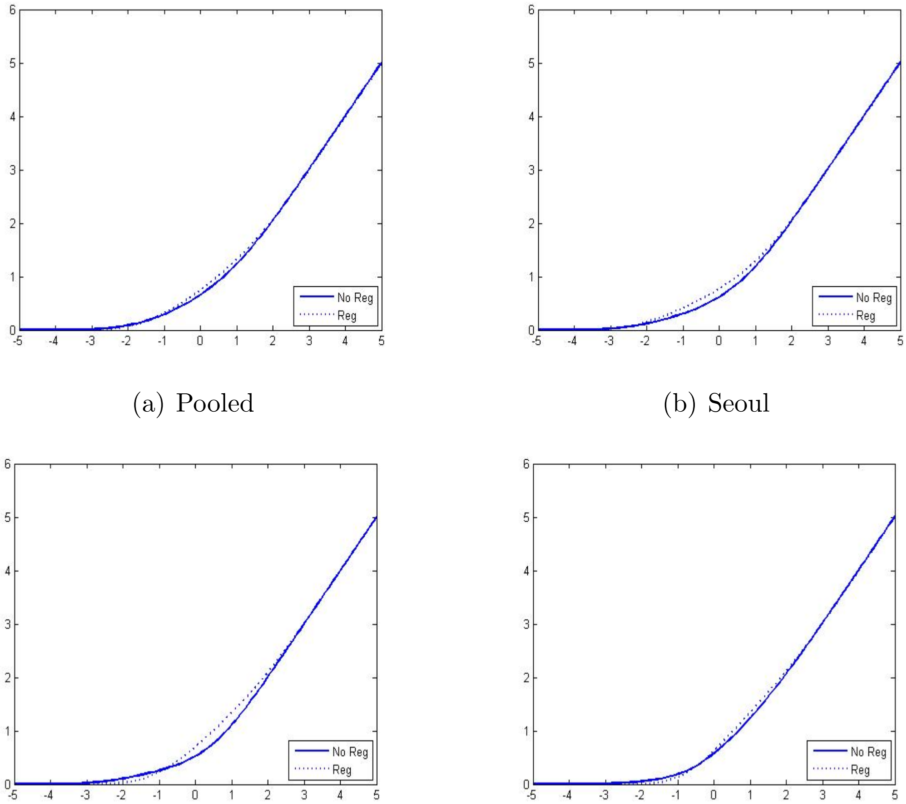
(c) Busan



(d) Jeonbuk

Figure 5: Second-Order Distributions with No Control

Note: Each figure shows second-order distribution with no control. In pooled case, comparing groups are whether there is regulation or not. Comparing years of Seoul region is 2008 (before regulation) and 2010 (after regulation), and Busan's comparing years are 2007 (before regulation) and 2009 (after regulation). In case of Jeonbuk, 2009 and 2010 are comparing years of regulation.

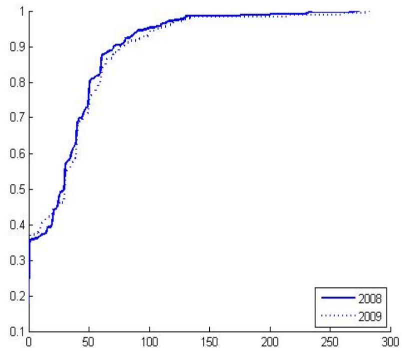


(a) Pooled (b) Seoul

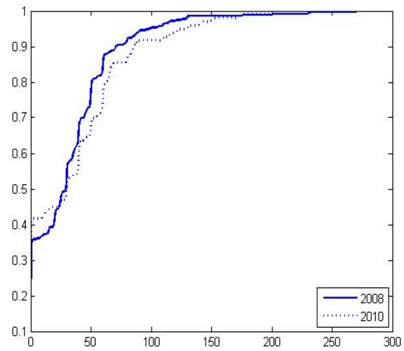
(c) Busan (d) Jeonbuk

Figure 6: Second-Order Distributions of Residuals

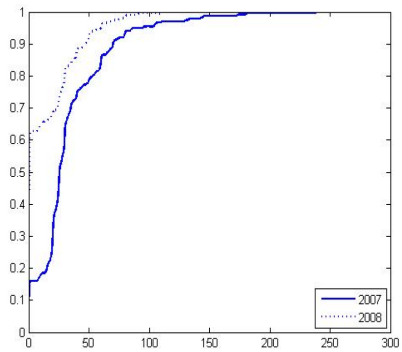
Note: Each figure shows second-order distribution of residuals from Pooled OLS estimation. In pooled case, comparing groups are whether there is regulation or not. Comparing years of Seoul region is 2008 (before regulation) and 2010 (after regulation), and Busan's comparing years are 2007 (before regulation) and 2009 (after regulation). In case of Jeonbuk, 2009 and 2010 are comparing years of regulation.



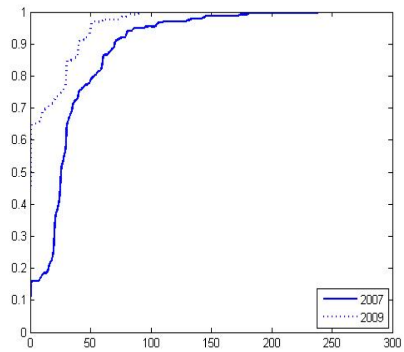
(a) Seoul 1



(b) Seoul 2



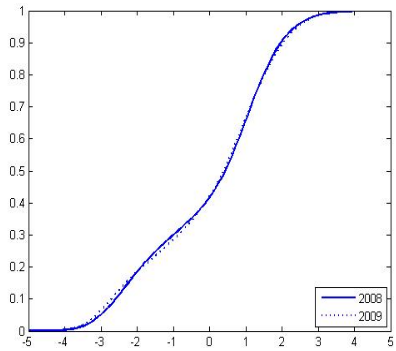
(c) Busan 1



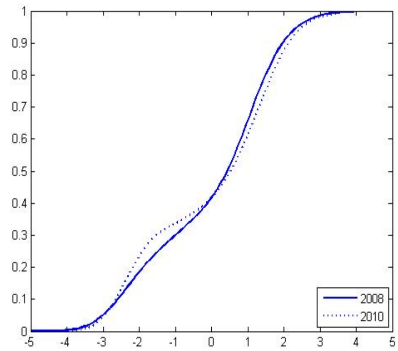
(d) Busan 2

Figure 7: Joint Hypothesis with No Control

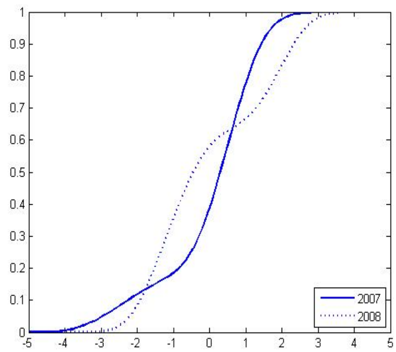
Note: Stochastic dominance test with no control in Seoul and Busan regions respectively. In Seoul, the base year of joint test is 2008. Thus, Seoul 1 presents CDF with no control in 2008 and 2009 while Seoul 2 is that of 2008 and 2010. On the other hand, the base year of Busan is 2007. Busan 1 represents CDF with no control in 2008 and 2009, and Busan 2 is CDF of residuals from 2009 and 2010.



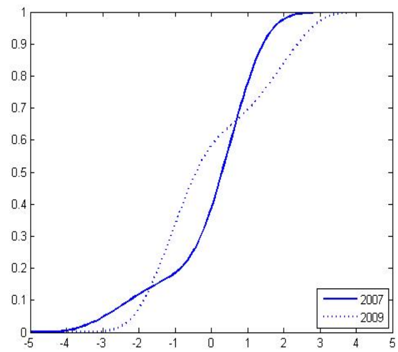
(a) Seoul 1



(b) Seoul 2



(c) Busan 1



(d) Busan 2

Figure 8: Joint Hypothesis: Residual Dominance

Note: Each figure shows CDFs of residuals from Pooled OLS estimation. In Seoul, the base year of joint test is 2008. Thus, Seoul 1 presents CDF of residuals in 2008 and 2009 while Seoul 2 is that of 2008 and 2010. On the other hand, the base year of Busan is 2007. Busan 1 represents CDF of residuals from 2008 and 2009, and Busan 2 is CDF of residuals from 2009 and 2010.

요약(국문초록)

한국의 치열한 대입 경쟁으로 인해 유발된 사교육에 대한 막대한 지출로 인해, 정부는 학원 교습시간에 대한 규제와 더불어 여러 사교육 규제 수단을 마련하는 데 노력을 기울여왔다. 본 논문은 한국고용정보원의 청년 패널 데이터(2007년-2010년)를 기반으로, 고등학생들에 대한 학원 교습시간 규제에 관한 효과를 분석하였다. 사교육비 패턴은 성별, 가구 소득, 부모의 학력, 학교 유형, 그리고 지역에 따라 다르게 나타난다. 이러한 사교육비 패턴 하에, 규제 효과는 각 지역에 따라 상이한 것으로 나타났다. 먼저, 패널 토빗 모형 추정을 하였을 때, 부산 지역은 학원 교습시간 규제가 사교육비 지출 감소에 유의미향 영향을 끼치는 것으로 나타난 반면, 서울 지역은 학원 교습시간 규제가 사교육비 지출 감소에 효과적이지 않은 것으로 나타났다. 또한, 본 논문에서는 규제 효과에 관해 지역별로 1차 및 2차 확률적 지배 검정(Stochastic Dominance Test)을 하였다. 확률적 지배 검정을 한 결과, 토빗 모형을 추정했을 때와 유사한 결과가 도출되었다.

주요어: 사교육비, 규제 효과, 토빗 모형, 확률적 지배, 부트스트랩

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