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Education Choice of Households and Income Inequality
- Empirical Research of Mixed Public and Private Education Model –

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Education Choice of Households and Income Inequality
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<Abstract>

This paper presents consideration of a case in which household education investment, which determines the human capital of children, is made using education of two types: public and private. Furthermore, these analyses based on prefectural panel data obtained for Japan are done using a theoretical model by which income inequality affects household education choice and illustrates empirically whether or not the choice of public and private education in junior and senior high school in Japan is affected by household income inequality and by the subsidy provided by central and local governments for high school tuition fees.

The analyses yield the following three results. First, in prefectures with high household income inequality, the preference for public education is slight. Second, a policy of no tuition fees for public high schools and a decrease in tuition fees for private high schools that started from 2010 do not affect public and private education choice for high school. Nevertheless, this policy strongly affects enrollment in private junior high schools. Third, an increase in subsidies for tuition fees of private high school started in 2014 raises preferences for private junior high schools and high schools. In addition, in the prefecture in which subsidies for tuition fees that are higher than the level decided by cental government and the subsidies own benefit for enrollment fees, enrollment in private high school is observed to be stimulated.

JEL Classifications: I24, H52

Keywords: Education choice, Income inequality, Public and private education

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1. Introduction

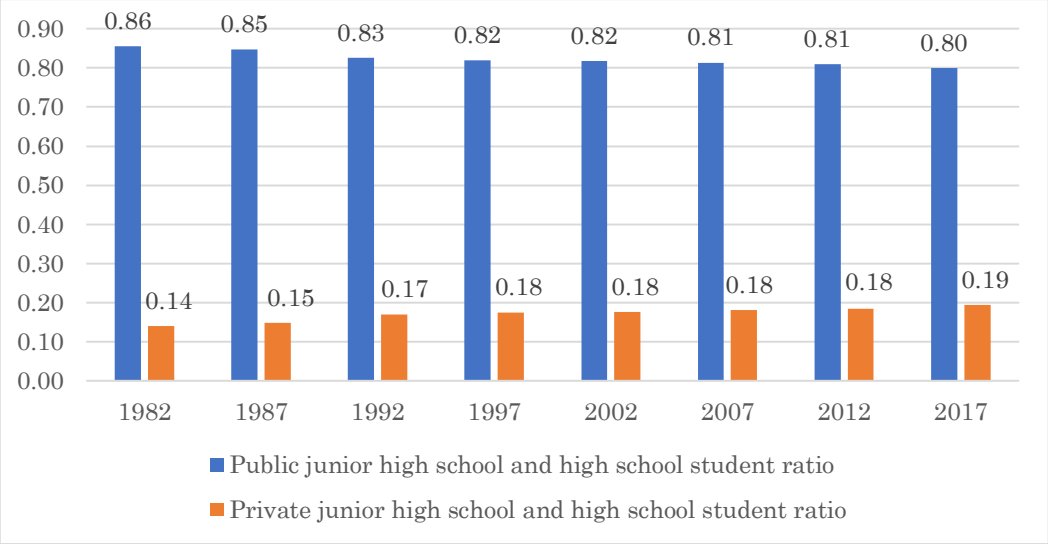
Education expenditures for children are regarded not only as a consumption good, but also an investment good. The choice of education system affects the economic growth and welfare of future generations because of human capital accumulation. Preferences for education depend strongly on the income level. Therefore, an increase in income inequality expands the hierarchy.

As related literature describing examinations of effects on income inequality, the level of human capital, and economic growth, reports present work by Glomm and Ravikumar (1992), Cardak (2004), Ray (2006), Futagami and Yanagihara (2008), and others. Glomm and Ravikumar (1992) examine how the average level of human capital stock and inequality of human capital between households are determined in a dynamics model by which the human capital of children depends on the human capital of their parents and the education investment made by parents for children. Cardak (2004) considers the case in which education modes of two types co-exist: public education and private education. Cardak (2004) sets the dynamics model in which the household choice of education affects the aggregate demand for public and private education and examines how public and private education affect the human capital stock in the long run. Ray (2006) considers the case in which households face a liquidity constraint and sets a dynamics model by which wage inequality between skilled labor and unskilled labor is determined endogenously by the private education provided by the households. Then, Ray (2006) demonstrates that income inequality brings about under-accumulation of human capital. Futagami and Yanagihara (2008) set a dynamics model in which the human capital of the children depends on the education time of the parent and shows that the growth rate of human capital and welfare differ between public education and private education.

Demand for education depends strongly on the income level. Figure 1-1-1 presents a time series of the ratio of junior high school and high school student in public and private education from the beginning of the 1980s to the mid-2010s. As a trend, although the student ratios of public junior high school and high school decrease, the student ratios of private junior high school and high school increase. In this period, considering that

the high school enrollment rate remains at a certain level, the household education choice is not uniform from the past to the present. It changes with time.

Fig. 1-1-1 Time series of student ratio of public and private junior high school and high school.



Note) These data do not include the early and late course of secondary school.
Data: "Fundamental school survey (Gakko Kihon Chosa)" (Ministry of Education, Culture, Sports, Science and Technology, Japan)

Therefore, the possibility must be considered that education choice by households is affected by a change of income distribution of households. In Japan, an increase in income inequality has been reported. Therefore, it is highly beneficial to examine, both theoretically and empirically, how income inequality affects education choice. However, among reports of the relevant literature such as those by Glomm and Ravikumar (1992), Cardak (2004), Ray (2006), and Futagami and Yanagihara (2008), none describes a study examining how the income inequality of a household affects education choice and human capital accumulation in a model with public and private education.[1]

Some empirical studies have examined household income and education choice. Carneiro and Heckman (2002) examine correlation between household income and

[1] Takii and Tanaka (2009) examine how income inequality and income growth are determined in the overlapping generations model in which the choice of public and private education affects the human capital distribution. Cardak (2004) also examines the income inequality and income growth in the overlapping-generations model in which the choice of public and private education affects the human capital distribution.

university enrollment based on individual data of younger people in the U.S.A. Based on panel data of younger people in the U.S.A., Belly and Lochner (2007) demonstrate that child ability and household income are factors affecting university enrollment rates. Matsuura and Shigeno (1996) show that the choice of private elementary and junior high school is correlated with the parent income and asset level and social status, based on individual household data. Sadahiro (2013) uses prefectural data from Japan to demonstrate that expenditures for additional education are deeply correlated with the household type. Based on individual data for children in Japan, Uzuki and Suetomi (2016) describe that household income affects additional education for elementary and junior high school via additional education expenditures in addition to those for school. Nevertheless, no report of the literature describes an empirical examination of public and private education choice and income inequality.

This paper presents consideration of a case in which household education investment determines the human capital of children that is given through education of two types: public education and private education. Furthermore, this paper explains a theoretical model by which income inequality affects the household education choice. In addition, based on prefectural panel data in Japan, an empirical examination is presented of whether or not the choice of public and private education in junior and senior high schools in Japan is affected by household income inequality, and by the subsidy provided by central and local governments for high school tuition fees.

2. Theoretical Model

In this section, we set the theoretical model illustrating how income inequality affects education choice when households face a choice of education modes: public education or private education. We set the model in 2.1. In 2.2, we examine how income and income inequality affect the share of households preferring public education.

2.1. Model setting

Households can obtain utility from consumption and education investment for children. The utility function is assumed as

$$u_t = \alpha \ln e + (1-\alpha)\ln c, 0 < \alpha < 1, \quad (1)$$

where c denotes consumption and e denotes education investment for children.

For a given income, a household allocates resources for education investment in children. There exist education of two types: public and private. Public education, which is financed by proportional income taxation, is available free of cost if households choose public education. Education investment per capita is therefore equal among children.

By contrast, each household choosing private education must incur a tax burden for public education in addition to its own private education costs. Then, the level of private education is determined to hold the desired level. Households make their own choices of public and private education. Therefore, the household budget constraint is

$$(1-x)e + c = (1-\tau)w^i. \quad (2)$$

In that equation, τ and w^i respectively denote the proportional income tax rate and the income $(0 < \tau < 1)$. Heterogeneity exists for income w^i among households. We assume that w^i is distributed in $[w^0, w^1]$. Also, x is the subsidy rate for private education $(0 < x < 1)$.[2] If the household chooses public education, then the education investment that they must pay for the education investment is zero: $e = 0$. However, if they choose private education, then $e > 0$ is obtainable.

In the case of private education, education investment and consumption are shown as

$$e = \frac{\alpha(1-\tau)w^i}{1-x}, \quad (3)$$

$$c = (1-\alpha)(1-\tau)w^i. \quad (4)$$

Substituting (3) and (4) into (1), we can obtain the indirect utility function by which households choose private education as shown below.

$$v^{pri} = \ln(1-\tau) + lnw^i + \alpha\ln\alpha + (1-\alpha)\ln(1-\alpha) - \alpha\ln(1-x), \quad (5)$$

If a household chooses public education, then the public education expenditure is

[2] This paper considers no tuition fee policy for public high schools established in 2010 and a subsidy policy for high schools established in 2014 and examines how these policies affect on the education choice with theoretical and empirical model.

$$\theta E + x\int_{w^*}^{w^1} \alpha \frac{(1-\tau)w^i}{1-x} w^i f(w^i) dw^i = \tau \int_{w^0}^{w^1} w^i f(w^i) dw^i, \tag{6}$$

where E and θ respectively denote the public education investment per capita and the share of households choosing public education. If households choose public education, then they can obtain E as the education level. In addition, $f(w^i)$ is the density function of w^i; (2) can be shown as $c = (1-\tau)w^i$. From this equation and by inputting (6) into the utility function, the indirect utility function by which households choose public education investment is shown as the following.

$$v^{pub} = \alpha \ln E + (1-\alpha)\ln(1-\tau)\, w^i \tag{7}$$

With $v^{pri} > v^{pub}$, that is, according to the following inequality, the households choose private education.

$$\ln w^i > \ln E - \ln(1-\tau) + \ln(1-x) - \ln\alpha - \frac{1-\alpha}{\alpha}\ln(1-\alpha) \tag{8}$$

Because of (8), one can obtain the following equation.

$$w^i > \frac{(1-x)E}{(1-\tau)\alpha(1-\alpha)^{\frac{1-\alpha}{\alpha}}} \tag{9}$$

We define w^* such that the following equation holds. We assume the parameter such that $w^0 < w^* < w^1$ holds.[3]

$$w^* = \frac{(1-x)E}{(1-\tau)\alpha(1-\alpha)^{\frac{1-\alpha}{\alpha}}} \tag{10}$$

Households that have $w^0 < w^i < w^*$ choose public education. Otherwise, it is $w^* < w^i < w^1$, indicating that the households choose private education. The ratio by which the households choose public education θ is determined such that the following equation holds.

$$\theta = \int_{w^0}^{w^*} f(w^i) dw^i \tag{11}$$

Considering (10) and (11), one can obtain the following equation.

[3] This assumption is necessary for households to choose public and private education in this model.

$$\theta = \int_{w^0}^{\frac{(1-x)E}{(1-\tau)\alpha(1-\alpha)^{\frac{1-\alpha}{\alpha}}}} f(w^i)dw^i. \tag{12}$$

This paper presents consideration that the level of public education is determined according to a probabilistic voting model. We assume social welfare function SW of the following form as[4]

$$\begin{aligned} SW &= \Omega v^{pub} + (1-\Omega)v^{pri} \\ &= \Omega\left(\alpha \ln E + (1-\alpha)\ln(1-\tau)\int_{w^0}^{w^*} w^i f(w^i)dw^i\right) \\ &+ (1-\Omega)\left(\ln(1-\tau) - \alpha\ln(1-x) + \ln\int_{w^*}^{w^1} w^i f(w^i)dw^i\right), \end{aligned} \tag{13}$$

where $0 < \Omega < 1$. Here, Ω denotes the weight parameter of how the government considers both public and private education.

The government provides public education services to maximize SW (13) subject to (6). Also, $\frac{\partial SW}{\partial E} = 0$ can be shown as presented below.

$$\frac{\alpha(1-\tau)}{E} = \left(1 - \alpha + \frac{1-\Omega}{\Omega}\right)\frac{\partial \tau}{\partial E} \tag{14}$$

Therein, $\frac{\partial \tau}{\partial E} = \frac{\theta}{\int_{w^0}^{w^1} w^i f(w^i)dw^i}$. Then, the share of household that selects public education θ is shown as presented below:

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[4] In this paper, we consider social welfare function that consist of indirect utility function that is average income households of public and private education, respectively. If we consider social welfare function as the total of indirect utility function, the social welfare function is shown as

$$SW = \Omega\int_{w^0}^{w^*} v^{pub} f(w^i)dw^i + (1-\Omega)\int_{w^*}^{w^1} v^{pri} f(w^i)dw^i.$$

Then, (14) can be presented as

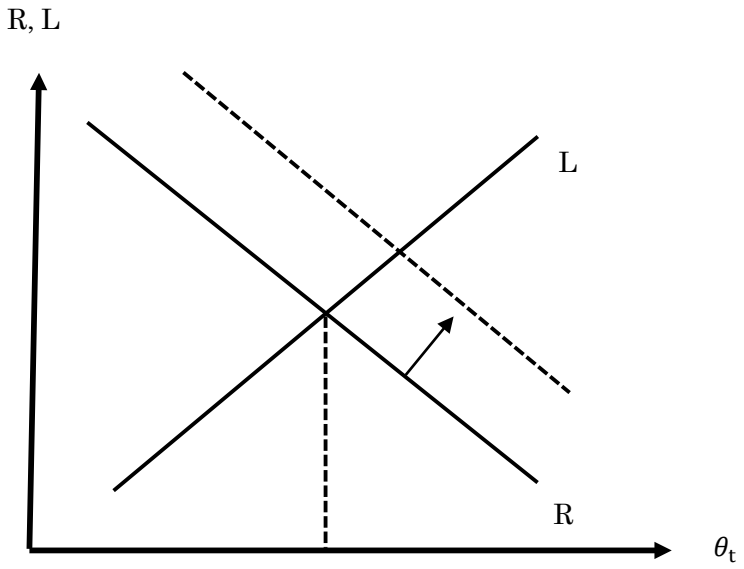
$$\frac{E}{\alpha(1-\tau)} = \frac{\int_{w^0}^{w^1} w^i f(w^i)dw^i}{\left(1 - \alpha + \frac{1-\Omega}{\Omega}\frac{1-\theta}{\theta}\right)\theta}.$$

It is difficult to derive the change of right hand side expressly for the change θ. Therefore, we consider social welfare function as (13). The subsidy rate of private education x is set as the parameter, different from the income tax rate τ and public education E. We think that this assumption is consistent with current education policy because the subsidy for private education is very small and this policy started recently. Then, we consider the maximization of public education.

$$\theta = \int_{w^0}^{\frac{(1-x)\int_{w^0}^{w^1} w^i f(w^i)dw^i}{\left(1-\alpha+\frac{1-\Omega}{\Omega}\right)\theta(1-\alpha)^{\frac{1-\alpha}{\alpha}}}} f(w^i)dw^i. \quad (15)$$

Actually, the left-hand side of (15) increases with θ, but the right-hand side decreases concomitantly with increasing θ. Designating the left-hand side and the right-hand side of (15) respectively as L and R, one can obtain the unique equilibrium and derive the following figure.

Figure 2-1-1 Determination of θ.



An increase in α pulls up line R because the right-hand side of (14) increases as shown by the dashed line. Consequently, the intersection of R and L moves upper-rightward; ratio θ rises.[5]

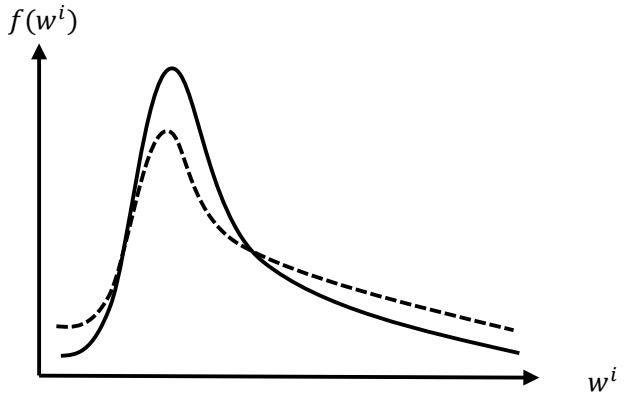
2.2. Increase in income inequality and the ratio preferring public education

We assume the income distribution as the log normal distribution by which the average and the variance are shown respectively as $\exp(\mu + \frac{\sigma^2}{2})$ and $\exp(2\mu + \sigma^2)(\exp(\sigma^2) - 1)$, and examine how the average and variance of the income affect ratio

[5] As shown by a simple calculation, one can verify that an increase in α raises w^* in (10). This shows an increase in θ as shown by (15).

θ. Because of the log normal distribution, $\ln w^i$ is given as a normal distribution with average μ and variance σ^2. Next, we consider the case of an increase in average $\exp(\mu + \frac{\sigma^2}{2})$ and variance $\exp(2\mu + \sigma^2)(\exp(\sigma^2) - 1)$ brought about by an increase in σ as income inequality. An increase in the variance in the model of log normal distribution changes the form of the density function as shown as the following figure.

Figure 2-2-1 Log normal distribution and an increase in the variance.



An increase in the variance changes from the form depicted by the solid line to the dashed line; also, the range widens. Then, defining the cumulative function as $F(w^i)$, the form can be depicted as the following figure The solid line represents the cumulative function before changing the variance. After changing, the dashed line can also be depicted.

Now, we examine how the parameters x, Ω, and σ affect the share of public education θ with the cumulative distributive function of log normal distribution. The cumulative distributive function of log normal distribution $F(w^i)$ can be shown as

$$F(w^i) = \frac{1}{2}\left(1 + \mathrm{erf}\left(\frac{\ln w^i - \mu}{\sigma\sqrt{2}}\right)\right) \tag{16}$$

where erf denotes the error function and the error function and $F(w^i)$ increase with w^i. Because of $\int_{w^0}^{w^1} w^i f(w^i) dw^i = \exp(\mu + \frac{\sigma^2}{2})$, (16) can be shown as follows.[6]

[6] We can check that μ is cancelled with calculation. We do not consider the change of μ because the change of average is that μ is cancelled and the change of μ does not affect θ.

$$\theta = \frac{1}{2}\left(1 + \mathrm{erf}\left(\frac{\ln\dfrac{(1-x)\int_{w^0}^{w^1} w^i f(w^i)dw^i}{\left(\left(1-\alpha+\dfrac{1-\Omega}{\Omega}\right)\theta(1-\alpha)^{\frac{1-\alpha}{\alpha}}\right)} - \mu}{\sigma\sqrt{2}}\right)\right) \tag{17}$$

$$= \frac{1}{2}\left(1 + \mathrm{erf}\left(\frac{\ln(1-x) - \ln\left(\left(1-\alpha+\dfrac{1-\Omega}{\Omega}\right)\theta(1-\alpha)^{\frac{1-\alpha}{\alpha}}\right)}{\sigma\sqrt{2}} + \frac{1}{2}\sqrt{\ln\left(\frac{\exp\left(\mu+\dfrac{\sigma^2}{2}\right)}{\exp(\mu)}\right)}\right)\right)$$

$\mathrm{erf}\left(\frac{\ln w^i - \mu}{\sigma\sqrt{2}}\right)$ increases with $\frac{\ln w^i - \mu}{\sigma\sqrt{2}}$. Then, defining $z = \frac{\ln(1-x) - \ln\left(\left(1-\alpha+\frac{1-\Omega}{\Omega}\right)\theta(1-\alpha)^{\frac{1-\alpha}{\alpha}}\right)}{\sigma\sqrt{2}} + \frac{1}{2}\sqrt{\ln\left(\frac{\exp\left(\mu+\frac{\sigma^2}{2}\right)}{\exp(\mu)}\right)}$, we can obtain the following equations:

$$\frac{d\theta}{dx} = -\frac{\frac{1}{2}\frac{\partial \mathrm{erf}}{\partial z}}{1 - \frac{1}{2}\frac{\partial \mathrm{erf}}{\partial z}\frac{\partial z}{\partial \theta}}\frac{1}{\sigma\sqrt{2}(1-x)} < 0 \tag{18}$$

$$\frac{d\theta}{d\Omega} = \frac{\frac{1}{2}\frac{\partial \mathrm{erf}}{\partial z}}{1 - \frac{1}{2}\frac{\partial \mathrm{erf}}{\partial z}\frac{\partial z}{\partial \theta}}\frac{1}{\sigma\sqrt{2}\Omega^2\left(1-\alpha+\frac{1-\Omega}{\Omega}\right)} > 0 \tag{19}$$

$$\frac{d\theta}{d\sigma} = \frac{\frac{1}{2}\frac{\partial \mathrm{erf}}{\partial z}}{1 - \frac{1}{2}\frac{\partial \mathrm{erf}}{\partial z}\frac{\partial z}{\partial \theta}}\frac{1 - \frac{2\ln\frac{1-x}{\left(1-\alpha+\frac{1-\Omega}{\Omega}\right)\theta(1-\alpha)^{\frac{1-\alpha}{\alpha}}}}{\sigma^2}}{2\sqrt{2}} >< 0 \tag{20}$$

However, an increase in σ does not always increase erf. An increase in σ raises of the first term of erf and reduces the second term.[7] An increase in subsidy rate for private education x reduces θ, with an increased α and Ω raising θ.

[7] We assume $\ln(1-x) - \ln\left(\left(1-\alpha+\frac{1-\Omega}{\Omega}\right)\theta(1-\alpha)^{\frac{1-\alpha}{\alpha}}\right) > 0$, that is, x is small. The government stated the policy of the subsidy for private education recently and compared it with the level of public education, the subsidy for private education is very small. Then, we consider that this assumption is consistent with the situation in Japan.

3. Empirical Research

This section presents an empirical examination, based on prefecture panel data, of whether income inequality affects the education choices related to public and private education in junior high school and high school in Japan. We set the model for the empirical examination as described in subsection 3.1. Subsection 3.2 explains the data. In subsection 3.3, we check and consider the estimation results and derive the policy implications.

3.1. Estimation model

This paper presents an examination of correlation between household education choice of public and private education and income inequality. Concretely, based on the theoretical model presented in section 2, equations (15) and (17) show that household income and income inequality affect the enrollment rates for public junior high schools and high schools. We can empirically examine the factors which determine the enrollment rate for public schools using the following linear regression model.

$$y_{it} = \alpha_0 + (\beta_1 + \beta_2 d_{2012} + \beta_3 d_{2017} + \beta_4 d_{2017} * d_{extra}) x_{it}^1 + \beta_5 ln x_{it}^2 + \beta_6 x_{it}^3 + \beta_7 x_{it}^4 + \sum_{1992}^{2017} \gamma_1 d_t + \gamma_2 d_{2017} * d_{extra} + \mu_i + \psi_t + \varepsilon_{it} \quad (21)$$

Therein, i $(= 47)$ and t $(= 1992,1997,2002,2007,2012,2017)$ respectively denote the indexes of the prefecture and fiscal year. The dependent variable y_{it} represents the enrollment in first grade of a public school. The explanatory variable x_{it}^1 shows the index of heterogeneity of household income. This index is obtainable by estimating the Fractionalization Index (FRAC), as reported by Taylor and Hudson (1972), based on data of the number of general households with children at each income level.[8] In addition, x_{it}^2 denotes the ratio of real income in the household of working generation to the median income in a general household with children.[9] In addition, x_{it}^3 denotes the

[8] Based on $\mathrm{FRAC} = \sum_{j=1}^{J} m_j(1 - m_j)$, we use data of general households with children at each income level and estimate them based on 'Shuugyoukouzoukihonchousa.' m_j denotes the ratio of the hierarchy of household income j to total households. As shown by the definition, if FRAC is close to 1, then the heterogeneity of the income within the region is high.

[9] This paper uses the ratio of the real income of the household with working generation to the median income of general households with children as the proxy variables of the ratio of the average to the

ratio of the public junior high schools and high schools to aggregate junior high schools and high schools in each prefecture. The rate of job openings to job seekers is x_{it}^4.

For these analyses, d_{2012} is a dummy variable for which 1 and 0 respectively denote 2012 and other years, to elucidate the effects of a no tuition fee policy for public high schools established in 2010. In addition, d_{2017} is a dummy variable for which 1 and 0 respectively denote 2017 and other years, to elucidate the effects of a subsidy policy for high schools established in 2014 by changing the old system.

Also, d_{extra} is a dummy variable representing the effects of an additional subsidy of prefectures over and above the central government level in the policy of subsidy for high school fees. A prefecture that presents an additional subsidy for more than 5.9 million JPY household or its own subsidy for enrollment fees is assigned 1. Otherwise, 0 is assigned as the value of the variable.

Additionally, μ_i and ψ_t respectively stand for the individual effect and time effect, whereas ε_{it} is an error term of $\varepsilon_{it} \sim iid(0, \sigma_{\varepsilon_i}^2)$.

If the education choice of public and private education in junior high school and high school is affected by household income inequality, then β_1 can be affected. It is important that a no-tuition fee policy for public high schools and a policy decreasing tuition fees for private high schools be provided simultaneously by the government. Therefore, we can reasonably infer increased enrollment not only for public high schools but also for private high schools. Therefore, we expect the sign of β_2 to be negative.

The high school subsidy policy is limited to households with a certain income. However, the decrease in tuition fees of public and private high schools for low income households is extended. Some prefectures provide self-subsidies for tuition fees that are higher than the level of central government. These effects promote the enrollment of private high schools and private junior high schools before enrollment for high school. Therefore, the signs of β_3 and β_4 can be expected to be negative.

median. Then, the sign of β_5 can be expected to be positive.

3.2. Data

Actually, (21) is estimated from prefecture panel data obtained for six years: 1992, 1997, 2002, 2007, 2012, and 2017. We explain the data as described hereinafter. Enrollment for the first grade of public junior high school or high school, which is the dependent variable, is derived by dividing the number of the first grade students of the public junior high schools and high schools (full time and part time) in each prefecture by the number of the first grade students of all junior high schools and all high schools (full time and part time) in each prefecture as shown by the Ministry of Education, Culture, Sports, Science and Technology 'Gakkoukihonchousa.'

To derive the heterogeneity index of household income, which is an explanatory variable, we estimate the FRAC Index based on data of the number of general households with children at each income level at each prefecture presented by Statistics Japan 'Shuugyoukouzoukihonchousa' and by Taylor and Hudson (1972).[10]

The ratio of real income and median income as an explanatory variable is derived as explained hereinafter. The former is derived by multiplying twelve times the average real monthly income of the household with working generation at each city in which the prefecture office is located, as shown by Statistics Japan 'Kakeichousa.' The latter is derived by estimating the annual income at each prefecture with the number of general households with children at each prefecture at each income level, as shown by Statistics Japan 'Shuugyoukouzoukihonchousa'.[11] Then the logarithm variables of the ratio of the two can be derived.

These two data are set as a real value with the deflator of aggregate expenditure in the prefecture, as shown by the Economic and Social Research Institute 'Kenminkeizaikeisan.'

The ratio of the public junior high schools and high schools as an explanatory variable is derived by dividing the respective numbers of public junior high schools and

[10] For these explanations, we use the number of the households with husband, wife, and children and the households with a husband, wife, their parents, and their children.

[11] Based on Nagamine and Okui (1999), Doi (2000), Takahashi and Miyamoto (2004) and others, we derive the income distribution at each prefecture and consider the household income that is given by the cumulative relative frequency 50% as the median income. Similarly to Nagamine and Okui (1999), we assume that households are distributed horizontally at each household income level.

high schools (full time and part time) by the total junior high schools and high schools (full time and part time) for prefectures, as shown by the Ministry of Education, Culture, Sports, Science and Technology 'Gakkoukihonchousa.' The ratio of job openings to job seekers was derived as an explanatory variable from data of the Ministry of Health, Labour and Welfare 'Shokugyouanteigyoumutoukei.' Descriptive statistics of the original data series of each variable are shown in Table 3-2-1.

Table 3-2-1 Descriptive Statistics.

Variable	Average	Standard deviation	Max.	Min.
Enrollment rate of first grade in public junior high schools	0.947	0.046	0.991	0.724
Enrollment rate of first grade in public high schools	0.753	0.090	0.976	0.422
FRAC	0.840	0.020	0.874	0.762
Real income (10 thousand JPY)	605.193	68.968	796.965	414.131
Median income (10 thousand JPY)	593.352	59.587	736.401	379.512
Ratio of public junior high schools	0.944	0.040	0.995	0.760
Ratio of public high schools	0.785	0.084	0.939	0.434
Ratio of job openings to job seekers	0.971	0.404	2.090	0.230

3.3. Results

This subsection presents results of estimation by the regression of (21). We also explain the implications of the results. Table 3-3-1 presents the results of the panel analysis of (21), which includes the dummy variable d_{extra} whether the additional subsidy for tuition fees exists in the prefecture or not in the policy of the subsidy for high school. Table 3-3-2 considers the dummy variable d_{extra} whether the subsidy for enrollment as prefecture own policy exists or not. Panels (a) and (b) respectively portray results obtained for public junior high schools and high schools in the table. In

estimation of (21), we select a pool model or fixed effects model with F tests and select a fixed effects model or random effects model with the Hausman test. As a result, this paper presents result of selected fixed effects model. We infer estimation of a two-way error component model that includes both the individual effect and a time effect because an aging population with fewer children is expected to progress and because the industrial structure and employment status are expected to change during the sample period.

Based on effects of the test for the model specifications, we confirm the statistical significance and the condition of the sign of the coefficient. First, FRAC (β_1) shows a negative sign and has significance in both (a) and (b) in Table 3-3-1 (additional subsidy for tuition fees) and Table 3-3-2 (prefecture own subsidy for enrollment fees). This result is consistent with the theoretical model that derives the relation between the level of income inequality of households and demand for public education. The logarithm of the ratio of real income and the median income (β_5) has no significance in either (a) or (b). Public junior high schools and high schools (β_6) show a positive sign and have significance in both (a) and (b) in Table 3-3-1 and Table 3-3-2. This result is consistent with the fact that of the number of public schools in the region is correlated with public school enrollment.

The intersection of FRAC and the dummy of the no tuition fee policy for public high schools (β_2) is negative with significance in (a) in Table 3-3-1 and Table 3-3-2. However, (b) is negative without significance. This result can be interpreted as follows. The no tuition fee policy for public high school includes a policy for decreasing tuition fees for private high schools for households with low income. Therefore, this effect does not affect the enrollment choice for public and private high schools. It facilitates enrollment for private junior high schools.[12] However, the intersection of FRAC and the dummy of the subsidy policy for high schools (β_3) is negative with significance in both (a) and (b) in Table 3-3-1 and Table 3-3-2. This result can be interpreted as follows. The policy for the

[12] As the reason for which β_3 is negative with significance in the result of (a), we can consider that the household expects more competition for the enrollment in public high school and prefers the application for an enrollment examination for a private junior high school at the early stage because of the policy of charging no tuition fees for public high school attendance.

high school tuition fee is renewed because the subsidy policy for high schools in 2014 that supported the old policy was changed.

Table 3-3-1 Estimation results of enrollment in the first grade of public school.

(Additional subsidy for tuition fees)

Parameter (Name of variable)	(a) Public junior high school	(b) Public high school
β_1 (FRAC)	-0.183***	-0.153*
	(0.061)	(0.084)
β_2 (FRAC) × d_{2012}	-0.216***	-0.130
	(0.060)	(0.123)
β_3 (FRAC) × d_{2017}	-0.463***	-0.140***
	(0.084)	(0.050)
β_4 (FRAC) × d_{2017} × d_{extra}	0.042	-1.092***
	(0.082)	(0.221)
β_5 ln (Real income/Median income)	-0.005	-0.020
	(0.003)	(0.016)
β_6 (Ratio of public school)	0.494***	0.248**
	(0.053)	(0.101)
β_7 (Ratio of the job openings to job seekers)	-0.011***	-0.014***
	(0.003)	(0.003)
F value	804.136***	599.518***
	(0.000)	(0.000)
Hausman	50.578***<8>	52.371***<8>
	(0.000)	(0.000)
AdjR^2	0.984	0.979
Sample size	282	282

Table 3-3-2 Estimation results of enrollment in the first grade of public school.

(Prefecture own subsidy for enrollment fees)

Parameter (Name of variable)	(a) Public junior high school	(b) Public high school
β_1 (FRAC)	-0.174***	-0.146**
	(0.057)	(0.068)
β_2 (FRAC) × d_{2012}	-0.213***	-0.128
	(0.056)	(0.125)
β_3 (FRAC) × d_{2017}	-0.538***	-0.233***
	(0.106)	(0.042)
β_4 (FRAC) ×d_{2017}×d_{extra}	0.276***	-0.186**
	(0.086)	(0.096)
β_5 ln (Real income/Median income)	-0.005	-0.017
	(0.004)	(0.013)
β_6 (Ratio of public school)	0.485***	0.255**
	(0.049)	(0.104)
β_7 (Ratio of the job openings to job seekers)	-0.010***	-0.014***
	(0.003)	(0.003)
F value	797.269***	607.822***
	(0.000)	(0.000)
Hausman	49.048***<8>	56.457***<8>
	(0.000)	(0.000)
Adj.R^2	0.984	0.979
Sample size	282	282

Note 1) Estimation results show the estimation of fixed effects model that is adopted as a result of test for the error for the model specification. For simplicity, the value of the constant term is omitted.

Note 2) ***, ** and * respectively portray the significance of two-sided test of 1%, 5% and 10%.

Note 3) Brackets in parameters show the heteroscedasticity robust standard error. AdjR^2 represents the adjusted R-square. Brackets in F value and Hausman show the *p*-value; the value of < > in Hausman represents the degrees of freedom.

Although this new policy has an income level constraint, the reduction in the amount of tuition fees for the private high schools is extended under this policy. Therefore, enrollment in public high schools is hindered, whereas enrollment in private high schools is facilitated. Similarly, enrollment in public junior high schools is hindered, but enrollment in private junior high schools is facilitated.

In addition, the coefficient term (β_4) of FRAC Index, an additional subsidy is provided by the prefecture for tuition fees, and a dummy of subsidy for tuition fees of high school with negative sign and significance are shown in Table 3-3-1 and Table 3-3-2. They show that enrollment in public high schools is hindered, whereas enrollment in private high schools is facilitated.

One can obtain the following three points of the determination of the enrollment for public schools as empirical research. First, the coefficient of FRAC β_1 is negative and significant in (a) and (b). Therefore, enrollment in public junior high schools and high schools tends to decrease in prefectures with high heterogeneity of household income. Second, the intersection coefficient of FRAC and the dummy of the no tuition policy for public high schools β_2 is negative with significance in (a), but it is not significant in (b). Therefore, this is no tuition policy for public high schools. The policy for a decrease in tuition fees for private high schools for low-income households do not affect enrollment choice for public and private high schools. However, enrollment in private junior high schools is facilitated. Third, the intersection coefficient of FRAC and the dummy of the subsidy policy for the high school β_3 and β_4 are negative with significance in (b). Therefore, enrollment in public high schools is hindered, although enrollment in private high schools is facilitated because of the policy for decreasing tuition fees for public and private high schools, even if this policy has an income level constraint.

4. Conclusions

This paper presents consideration of a case in which household education investment determines the human capital of children that is given through education of two types: public education and private education. Furthermore, this paper explains a theoretical

model by which income inequality affects the household education choice. In addition, based on prefectural panel data in Japan, an empirical examination is presented of whether or not the choice of public and private education in junior and senior high schools in Japan is affected by household income inequality, and by the subsidy provided by central and local governments for tuition fee of high school.

As results of empirical studies, we can obtain the following three points. First, the coefficient of FRAC index β_1 is negative and has significance. Therefore, enrollment for public junior high schools and high schools is low for prefectures in which income inequality is high. Second, the coefficient of intersection of the FRAC index and the dummy of the policy of no intuition fee for public high school β_2 is negative, with significance found for the estimation of public junior high schools. However, in the case of public high school, no significance was found. Results demonstrate that the policy of no tuition fee for public high schools and the subsidy for decreasing tuition fees for the private high schools does not affect public and private education choice. However, enrollment for private junior high schools is facilitated. Third, the coefficient of the intersection of the FRAC index and the dummy of the policy for the subsidy for the tuition fees of high school β_3 and β_4 is negative and has significance. Therefore, even if this policy has an income constraint, an increase in households affected by a policy of a decreased tuition fees for private high schools raises enrollment in private high schools (enrollment in public high schools is hindered). In addition, this result is enforced in prefectures that provide their own policy for tuition fee and enrollment fee assistance.

A series of empirical studies can be undertaken to assess effects of an increase in income inequality on public and private education choices for junior high school and high school in Japan. Studies can also assess which subsidy for public or private high schools has a more positive effect on the choice of private education. A future increase in income inequality among households can be anticipated. Therefore, subsidies for tuition fees for high school should be continued and applied to every type of school to maintain neutrality for education choice that depends on the household income level.

Finally, two points should be underscored. The first is derivation of regression that incorporates private supplementary tutoring. As a feature of education costs in Japan,

high additional education costs are imposed by test preparatory schools and tutors. Although it is important to assess how education aside from school education affects education choice, these expenditures are not considered in the empirical research described in this paper. Paid education fee data for each prefecture are obtainable from 'Kakeichousa' and 'Zenkokushouhijittaichousa' data. Therefore, some room for improvement can be found for this study simply by using regression analysis that incorporates the endogeneity problem with a dummy variable representing public subsidies for tuition fees and additional education expenditures other than those for the school.

The second point is setting of the theoretical model. These analyses assume a simple model as the log utility function and the density function given by the log normal distribution for ease of examination. The results can change according to this assumption. However, it is insufficient to examine that assumption. Moreover, the theoretical model does not include additional education costs except for those related to school. For that reason, these effects on the results can not be examined. Therefore, it is necessary for future research that the model be set to resolve the difficulties described above.

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