Education Choice of Households and Income Inequality
– Empirical Analysis of a Mixed Public and Private Education Model –

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<Abstract>

This paper presents consideration of a case in which household education investment that determines the human capital of children is made using education of two types: public and private. Furthermore, this paper sets a theoretical model by which income inequality affects household education choice and examines empirically whether the choice of public and private education in junior and senior high school in Japan is affected by household income inequality or not, based on prefectural panel data obtained for Japan.

We obtain 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 fee for public high schools and a decrease in tuition fees for private high schools that started from 2010 does not affect the choice of public and private education 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 the preference for private junior high schools and high schools.

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Keywords: Income inequality, Public and private education, Voting

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1. Introduction

Education expenditure for children is 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. The preference for education depends largely 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 the inequality of human capital between households are determined in the 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 coexist: 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 the 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 the education depends strongly on the income level. 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 examine household income and education choice. Carneiro and Heckman (2002) examine correlation between household income and 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 the ability of children and household income are factors affecting the rate of enrollment in universities. 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, except for elementary and junior high school, via additional education expenditures other than 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. Also, based on prefectural panel data in Japan, an empirical examination is presented of whether the choice of public and private education in junior and senior high schools in Japan is affected by household income inequality, or not.

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 distribution of human capital.
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

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

(1)

where \( e \) and \( c \) respectively denote education investment for children and consumption.

For a given income, a household allocates resources for education investment in children. There exist two types of education: 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 equal among children.

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

\[ e + c = (1 - \tau)w^t. \]  

(2)

In that equation, \( \tau \) and \( w^t \) respectively denote the proportional income tax rate and the income. Heterogeneity exists for income \( w^t \) among households: we assume that \( w^t \) is distributed in \([w^0, w^1]\). 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

\[ e = \alpha(1 - \tau)w^i, \quad (3) \]

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

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

\[ v^{pri} = \ln(1 - \tau) + \ln w^i + \alpha \ln \alpha + (1 - \alpha) \ln(1 - \alpha) \quad (5) \]

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

\[ \theta E = \tau \int_{w\theta}^{w^1} w^i f(w^i)dw^i, \quad (6) \]

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

\[ v^{pub} = \alpha \ln E + (1 - \alpha) \ln c = \alpha \ln \frac{\tau \int_{w\theta}^{w^1} w^i f(w^i)dw^i}{\theta} + (1 - \alpha) \ln(1 - \tau)w^i \]

\[ = \alpha \ln \tau + \alpha \ln \int_{w\theta}^{w^1} w^i f(w^i)dw^i - \alpha \ln \tau + (1 - \alpha) \ln(1 - \tau)w^i \quad (7) \]

With \( v^{pri} > v^{pub} \), that is, with the following inequality holding, the households choose private education.

\[ \ln w^i > \ln \tau - \ln(1 - \tau) + \ln \int_{w\theta}^{w^1} w^i f(w^i)dw^i - \ln \tau - \ln \alpha 
- \frac{1 - \alpha}{\alpha} \ln(1 - \alpha) \quad (8) \]

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

\[ w^i > \frac{\tau \int_{w\theta}^{w^1} w^i f(w^i)dw^i}{(1 - \tau) \theta \alpha (1 - \alpha) \frac{1 - \alpha}{\alpha}} \quad (9) \]

We define \( w^* \) such that the following equation holds. We assume the parameter
such that $w^0 < w^* < w^1$ holds.\(^2\)

\[
w^* = \frac{\tau \int_{w^0}^{w^1} w^i f(w^i) dw^i}{(1 - \tau) \theta a (1 - a) \frac{1 - a}{\alpha}}
\]  

(10)

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

\[
\theta = \int_{w^0}^{w^*} f(w^i) dw^i
\]

(11)

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

\[
\theta = \int_{w^0}^{w^*} \frac{\tau \int_{w^0}^{w^1} w^i f(w^i) dw^i}{(1 - \tau) \theta a (1 - a) \frac{1 - a}{\alpha^2}} f(w^i) dw^i.
\]

(12)

Now, we consider the equilibrium using the median voter theorem. Then, the level of public education is given by majority voting. The level of the public education that households want differs between households because the level depends on the household income level. Households that prefer the public education choose the tax rate $\tau$ to maximize utility (7), shown as\(^3\)

\[
\frac{\alpha}{\tau} - \frac{1 - \alpha}{1 - \tau} = 0 \rightarrow \tau = \alpha.
\]

(13)

By contrast, households that prefer private education choose $\tau = 0$. If the median voter prefers public education, then the tax rate to finance public education is positive $\tau > \alpha$. Defining the income level of the median voter and the tax rate that is preferred by the median voter as $w^m$ and $\tau^m$, respectively, we can obtain $\tau^m = \alpha$ in the case of $w^m < w^*$. However, with $w^m > w^*$, the tax rate to finance public education is zero $\tau^m = 0$ because the median voter prefers a private education. Considering (12) and (13), one can obtain the following equation.

\(^2\) This assumption is necessary for households to choose public and private education in this model.

\(^3\) In this model, the optimal tax rate chosen by households that prefer public education is the same and is independent of $w^i$ even if this paper considers the tax rate preferred by the median voter. The households choose public or private education to maximize their utility for a given tax rate. Finally, the ratio of households that prefer public education is given by the politically preferred tax rate. This paper includes no consideration of how the tax rate affects the ratio of public education in considering the tax rate.
The left-hand side of (14) increases with $\theta$, but the right-hand side decreases with increasing $\theta$. Designating the left-hand side and the right-hand side of (14) respectively as $L$ and $R$, one can obtain the unique equilibrium and show the following figure.

Figure 2-1-1 Determination of $\theta$.

An increase in $\alpha$ 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 $\theta$ rises.$^4$

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 $\exp(\mu + \frac{\sigma^2}{2})$ and $\exp(2\mu + \sigma^2)(\exp(\sigma^2) - 1)$, respectively, and examine how the average and variance of the income affect ratio $\theta$. Because of the log normal distribution, $\ln w^1$ is given by a normal distribution with average $\mu$ and

$^4$ As shown by a simple calculation, one can verify that an increase in $\alpha$ raises $w^*$ in (10). This shows an increase in $\theta$ as shown by (14).
variance $\sigma^2$. 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 $\sigma$ as income inequality. An increase in the variance in the model of log normal distribution changes the form of the density function as shown by the following figure.

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

\[ f(w^i) \]

$w^i$

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.

Figure 2-2-2 Cumulative function and an increase in the variance.

\[ F(w^i) \]

$w^i$
Because of \( w^* = \frac{\int_{w_0}^{w_1} w f(w) dw}{\theta (1 - \alpha)^2} \) and \( \ln w^* = \mu + \frac{\sigma^2}{2} - \ln \theta (1 - \alpha)^{\frac{1}{2}} > \mu + \frac{\sigma^2}{2} > \mu \), \( \ln w^* \) is located at the right of \( \mu \), as shown in the figure.\(^5\) In the case shown in the figure, an increase in \( \sigma \) reduces the value of the cumulative function for given \( w^* \). This result corresponds to reduction of the value of the right-hand side of (14); \( R \) moves leftward down in Figure 2\(-1\): then \( \theta \) decreases.

However, if \( \mu \) is very small and \( \ln w^* \) is located at the left of the intersect between the solid line and dashed line, an increase in \( \sigma \) raises the value of the cumulative function for given \( w^* \). This result indicates that the value of right-hand side of (14) increases and \( \theta \) increases. As the results show, the effect of an increase in \( \sigma \) on \( \theta \) is positive or negative.

Simultaneously, an increase in \( \sigma \) raises the average \( \exp(\mu + \frac{\sigma^2}{2}) \). Then, \( w^* \) increases. As shown by Figure 2\(-2\), if \( w^* \) is located at the left of the intersect, then the value of the cumulative function decreases and the right-hand side of (14) decreases. Therefore, \( R \) moves lower leftward in Figure 2\(-1\): also, \( \theta \) decreases. However, the move of \( w^* \) has a positive effect on \( \theta \). In fact, \( \theta \) increases if this effect is large.

We consider concretely the equation of the log normal distribution for the result described above. The equation of the cumulative function of the log normal distribution is

\[
F(w^i) = \frac{1}{2} \left( 1 + erf \left( \frac{\ln w^i - \mu}{\sigma \sqrt{2}} \right) \right) .
\]  

Therein, \( erf \) denotes the error function. An increase in \( w^i \) raises \( erf \) and \( F(w^i) \). Because of \( \int_{w_0}^{w_1} w f(w^i) dw^i = \exp(\mu + \frac{\sigma^2}{2}) \), (15) can be expressed as shown below.\(^6\)

\(^5\) Because the median income is \( \exp(\mu) \) and because the average income is \( \exp \left( \mu + \frac{\sigma^2}{2} \right) \), which is more than the median income, more than half of households choose public education. With voting, we can obtain the equilibrium in which public education exists.

\(^6\) As shown in this equation, \( \mu \) can be erased. Therefore, we do not consider the change of \( \mu \) as the average income.
\[
\theta = \int_{w_0}^{\theta(1-a)\frac{1}{\theta}} f(w')dw' = \frac{1}{2} \left( 1 + \text{erf} \left( \frac{\exp \left( \mu + \frac{\sigma^2}{2} \right) - \mu \theta(1-a)\frac{1}{\theta}}{\frac{1}{\sqrt{\sigma^2}} - \ln \theta(1-a)\frac{1}{\theta}} \right) \right)
\]

(16)

As shown there, \( \text{erf} \) increases with \( \frac{\sigma^2}{2} - \ln \theta(1-a)\frac{1}{\theta} \). An increase in \( \sigma \) does not always increase \( \text{erf} \). With small \( \ln \theta(1-a)\frac{1}{\theta} \), an increase in \( \sigma \) increases \( \text{erf} \) and \( \theta \) rises. However, with large \( \ln \theta(1-a)\frac{1}{\theta} \), an increase in \( \sigma \) increases \( \text{erf} \) and \( \theta \) falls.\(^7\)

3. Empirical Analysis

This section presents an empirical examination, based on prefecture panel data, of whether the education choice of public and private education in junior high school and high school in Japan is affected by income inequality. We set the model for the empirical examination as described in 3.1. In 3.2, we explain the data. In 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 (14) and (16) 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 that determine the enrollment rate for public schools using the following linear regression model.

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\(^7\) Because \( \text{erf} \) includes \( \frac{\ln \theta(1-a)\frac{1}{\theta}}{\sigma} \), an increase in \( \sigma \) does not always increase \( \text{erf} \) for the reason that an increase in \( \sigma \) increases \( \frac{\sigma}{2\sqrt{2}} \) and decreases \( -\frac{\ln \theta(1-a)\frac{1}{\theta}}{\sigma} \). If the negative effect on \( -\frac{\ln \theta(1-a)\frac{1}{\theta}}{\sigma} \) is slight, then an increase in \( \sigma \) raises \( \text{erf} \) and \( \theta \), and vice versa.
\[ y_{it} = \alpha_0 + (\beta_1 + \beta_2 d_{2012} + \beta_3 d_{2017}) x_{it}^1 + \beta_4 \ln x_{it}^2 + \beta_5 x_{it}^3 + \beta_6 x_{it}^4 + \mu_i + \psi_t + \varepsilon_{it} \] (17)

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.\(^8\) Also, \( x_{it}^2 \) denotes the ratio of real income in the household of working generation to the median income in a general household with children.\(^9\) Also, \( x_{it}^3 \) denotes the ratio of the public junior high schools and high schools to aggregate junior high schools and high schools in each prefecture. The effective job to unemployment ratio 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 consider the effects of a no tuition fee policy for public high schools established in 2010. Also, \( d_{2017} \) is a dummy variable for which 1 and 0 respectively denote 2017 and other years, to consider the effects of a subsidy policy for high schools established in 2014 by changing the old system. Additionally, \( \mu_i \) and \( \psi_t \) respectively stand for the individual effect and time effect, whereas \( \varepsilon_{it} \) is an error term of \( \varepsilon_{it} \sim iid(0, \sigma_\varepsilon) \).

If the education choice of public and private education in junior high school and high school is affected by household income inequality, then \( \beta_1 \) can be statistically significant. Because the no tuition fee policy for public junior high school and the policy decreasing tuition fees for private high schools are simultaneously provided by the government, we can reasonably infer increased enrollment for both public and private

\(^8\) Based on \( FRAC = \sum_{j=1}^{J} m_j \left(1 - m_j\right) \), 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.

\(^9\) With simple calculations, we can check that the first term in the numerator in (16) corresponds to the log value of the ratio of the average value to the median value of log normal distribution \( \ln \left( \frac{\exp(\mu + \frac{\sigma^2}{2})}{\exp(\mu)} \right) > 0 \). 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 median. Then, the sign of \( \beta_4 \) can be expected to be positive.
junior high schools and high schools. Therefore, we expect the sign of $\beta_2$ to be negative. However, even if an income constraint exists in the subsidy policy for high schools, this policy is applied to private high schools. This policy facilitates enrollment for private high schools and the private junior high schools. Therefore, we expect the sign of $\beta_3$ to be negative.

3.2. Data

Actually, (17) is estimated from prefecture panel data obtained for six years (1992, 1997, 2002, 2007, 2012, 2017). We explain the data as presented 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 The School Basic Survey ('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 shown by Statistics Japan Employment Status Survey ('Shuugyoukouzoukihonchousa') and by Taylor and Hudson (1972).

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 Family Income and Expenditure Survey ('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 Employment Status.

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10 For these explanations, we use the number of the households with husband, wife and children and the households with husband, wife and their parents and children.
Then the logarithm variables of the ratio of the two can be derived. These two data are set as the 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 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 The School Basic Survey (‘Gakkoukihonchousa’). The ratio of job openings to unemployment was derived as an explanatory variable from data of the Ministry of Health, Labour and Welfare Employment Referrals for General Workers (‘Shokugyouanteigyoumutoukei’). A description of the statistics of the original data series of each variable is shown in Figure 3-2-1.

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

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.
3.3. Results

In this subsection, we present results of estimation by the regression of (17). We explain the implications of the results. Figure 3-3-2 presents the results of the panel analysis of (17) by which dependent variables are the enrollment numbers of first grade of public junior high schools and high schools. Panels (a) and (b) respectively portray the results obtained for public junior high schools and high schools in this figure. Figure 3-3-1 presents results of the adopted fixed effects model. 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. 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 check the statistical significance and the condition of the sign of the coefficient. First, FRAC ($\beta_1$) shows a negative sign and has significance in both (a) and (b). 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 ($\beta_4$) has no significance in either (a) or (b). Public junior high schools and high schools ($\beta_7$) show a positive sign and have significance in both (a) and (b). This result is consistent with the fact that 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 ($\beta_2$) is negative with significance in (a). However, (b) is negative without significance found. This result can be interpreted as follows. The no tuition fee policy for public high school includes a policy for a decrease in 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. However, the intersection of FRAC and the dummy of the subsidy policy for

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12 As the reason that $\beta_3$ 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
high schools ($\beta_3$) is negative with significance in both (a) and (b). This result can be interpreted as follows. The policy for the high school tuition fee is renewed because the subsidy policy for high schools in 2014 that provided the old policy was changed.

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

<table>
<thead>
<tr>
<th>Parameter (Name of variable)</th>
<th>(a) Public junior high school</th>
<th>(b) Public high school</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\beta_1$ (FRAC)</td>
<td>-0.186***</td>
<td>-0.162**</td>
</tr>
<tr>
<td></td>
<td>(0.059)</td>
<td>(0.070)</td>
</tr>
<tr>
<td>$\beta_2$ (FRAC) $\times d_{2012}$</td>
<td>-0.211***</td>
<td>-0.122</td>
</tr>
<tr>
<td></td>
<td>(0.054)</td>
<td>(0.123)</td>
</tr>
<tr>
<td>$\beta_3$ (FRAC) $\times d_{2017}$</td>
<td>-0.461***</td>
<td>-0.364***</td>
</tr>
<tr>
<td></td>
<td>(0.066)</td>
<td>(0.066)</td>
</tr>
<tr>
<td>$\beta_4$ ln (Real income/Median income)</td>
<td>-0.004</td>
<td>-0.012</td>
</tr>
<tr>
<td></td>
<td>(0.004)</td>
<td>(0.013)</td>
</tr>
<tr>
<td>$\beta_5$ (Ratio of public school)</td>
<td>0.498***</td>
<td>0.260**</td>
</tr>
<tr>
<td></td>
<td>(0.053)</td>
<td>(0.104)</td>
</tr>
<tr>
<td>$\beta_6$ (Ratio of the job openings to unemployment)</td>
<td>-0.011***</td>
<td>-0.014***</td>
</tr>
<tr>
<td></td>
<td>(0.003)</td>
<td>(0.003)</td>
</tr>
<tr>
<td>F value</td>
<td>792.029***</td>
<td>598.354***</td>
</tr>
<tr>
<td></td>
<td>(0.000)</td>
<td>(0.000)</td>
</tr>
<tr>
<td>Hausman</td>
<td>45.441***&lt;6&gt;</td>
<td>52.571***&lt;6&gt;</td>
</tr>
<tr>
<td></td>
<td>(0.000)</td>
<td>(0.000)</td>
</tr>
<tr>
<td>Adj $R^2$</td>
<td>0.984</td>
<td>0.979</td>
</tr>
<tr>
<td>Sample size</td>
<td>282</td>
<td>282</td>
</tr>
</tbody>
</table>

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 robust standard error for ununiformed variances. Adj $R^2$ represents the degrees of freedom corrected coefficient of determination. Brackets in F value and Hausman show the $p$-value; the value of $<$ in Hausman represents the degrees of freedom.

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.
Although this new policy has the income level constraint, this policy more decreases the tuition fee for the private high schools. Therefore, enrollment in public high schools is hindered, whereas enrollment in private high school is facilitated. Similarly, enrollment in public junior high schools is hindered, but 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 $\beta_1$ 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 $\beta_2$ is negative with significance in (a), but it is not significant in (b). Therefore, this no tuition policy and 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 $\beta_3$ is negative with significance in both (a) and (b). Therefore, enrollment in public junior high schools is hindered, although enrollment in private junior high schools and high schools is facilitated, because of the policy for more decreased tuition fees for private high schools, even if this policy has an income level constraint.

4. Conclusions

This paper presents consideration of education investment, which gives human capital to children, as determined by choices of public and private education. We set the theoretical model by which income inequality affects household education choice and examine empirically whether the choice of public and private education at the stage of junior high school and high school is affected by income inequality, or not.

Concretely, we set a model by which households that have heterogeneity of income choose the education mode: public or private. Theoretically, we derive results showing that the income distribution affects not only the education investment of households but also the choice of public and private education via majority voting. Moreover, we
examine empirically whether the public school enrollment rate is affected by income and income inequality, or not, based on prefecture panel data.

As empirical studies, we can obtain the following three points. First, the coefficient of FRAC index $\beta_1$ 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 $\beta_2$ 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 policy for a decrease of tuition fees for the private high schools does not affect the public and private education choice. However, the 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 fee of high school is negative and has significance. Therefore, even if this policy has an income constraint, an increase in households affected by a policy of a more decreased tuition fees for private high schools raises enrollment in private junior high schools and high schools and reduces enrollment in public junior high schools and high schools.

A series of empirical studies can be considered 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. An increase in income inequality among households is anticipated in the future. Therefore, subsidies for tuition fees for high school should be continued and applied to every type of school to hold 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 educational opportunity that requires tuition fees. As a feature of education costs in Japan, additional education costs imposed by test preparatory schools and tutors are high. 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
can be obtained from Family Income and Expenditure Survey (Kakeichousa') and National Survey of Family Income and Expenditure ('Zenkokushouhijittaichousa'). Therefore, some room for improvement exists for this study simply by using a 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 assistance for high school students and additional education costs except for those related to school. For that reason, we cannot examine these effects on the results. Therefore, it is necessary to set the model to resolve the difficulties described above in future research.
References


Data

Ministry of Internal Affairs and Communications Family Income and Expenditure Survey ‘Kakeichousa’ (in Japanese)

Ministry of Internal Affairs and Communications Employment Status Survey ‘Shuugyoukouzoukihonchousa’ (in Japanese)


Economics and Social Research Institute ‘Kenminkeizaisannenpou’ (in Japanese)

Appendix A. The Case of a Normal Distribution

This paper presents examination of income inequality and education choice in the case of a log normal distribution. This appendix presents consideration of the case of a normal distribution. With a normal distribution with average \( \mu \) and variance \( \sigma^2 \), an increase in the variance changes the form of the cumulative function from the solid line to the dashed line, as shown in the following figure.

**Figure A-1-1** Form of cumulative function and an increase in the variance.

\[
F(w^i) = \frac{1}{2} \left(1 + \text{erf} \left( \frac{w^i - \mu}{\sigma \sqrt{2}} \right) \right).
\]  
(A.1)

Because of \( w^* = \int_{w_0}^{\mu} \frac{w^i f(w)}{\theta (1 - \alpha)^\pi} dw^i = \frac{\mu}{\theta (1 - \alpha)^\pi} \) in the case of a normal distribution, the share of the public education \( \theta \) is the following.

\[
\theta = \int_{w_0}^{\mu} \frac{1}{\theta (1 - \alpha)^\pi} f(w^i) dw^i = \frac{1}{2} \left(1 + \text{erf} \left( \frac{1}{\theta (1 - \alpha)^\pi} \frac{\mu}{\sigma \sqrt{2}} \right) \right).
\]  
(A.2)

As shown by this equation, an increase in \( \mu \) raises \( \theta \). However, an increase in \( \sigma \) reduces \( \theta \).