Do the Elderly Support Public Educational Expenditure? An Empirical Analysis Focusing on the Characteristics of Spending

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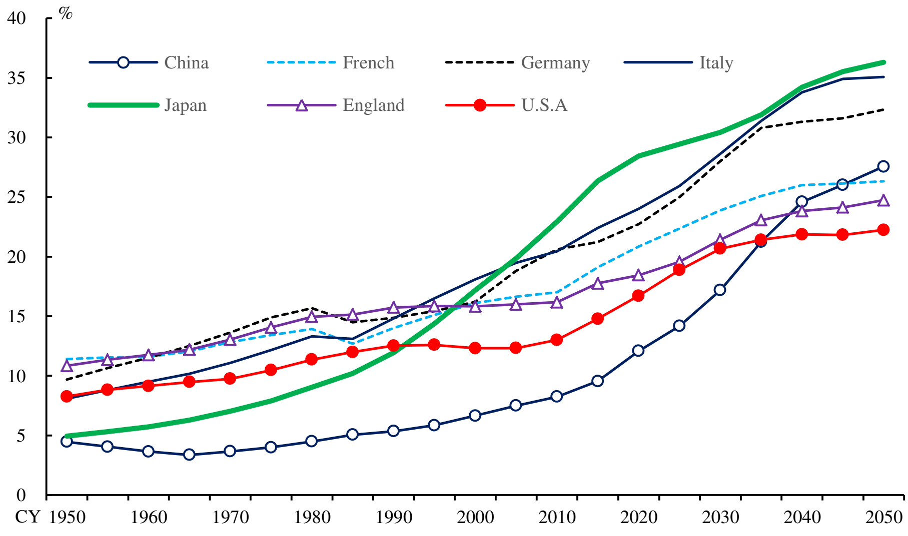
I. Background and objective

Japan's population is aging faster than it is in any other developed country (Chart Ⅰ-1). According to the National Census, Japan's elderly population (aged 65 and above) will reach about 30% of all Japanese people in 10 years and 36% in 30 years. How will this rapid aging impact government expenditure? According to the median voter theorem, preferences for the elderly in government decision-making have had an increased impact on government expenditure, matching the aging population. While government expenditure is expected to increase in programs that provide many direct benefits for the elderly, such as medical expenses and pensions during those periods, supporting government expenditures for the younger generation will become difficult too, since such programs will not likely provide direct benefits for the elderly. This paper focuses on educational expenditures, which is intuitively thought to lack direct benefits for the elderly, and analyzes the impact of aging on such expenditure.

Chart I-1: Percentage of people over 65 years old (seven major countries)



Note: The figures after 2020 are median estimated values.
Resource: United Nations, "World Population Prospects: The 2015 Revision Population Database."

To investigate the relationship between aging and educational expenditure, Miyaki and Kimura

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(2018) conducted an estimation to Japanese prefectural data during 1975–2013 (39 years). The paper is the first attempt in Japan which applies analysis to every educational stage—from kindergarten to university—and shows differences in the impacts of aging on each stage. In this paper, we develop Miyaki and Kimura (2018) and focus on educational expenditure classified by character. Educational expenditure can be broadly categorized into current spending and capital spending. Since the purpose of these two expenditure categories is different, a voter's preference toward them might be, too. For example, when the Democratic Party of Japan took power in 2009 after a long-term rule by the opposition party, it criticized the old regime's way of undertaking economy-boosting measures by utilizing heavy public construction projects. Instead, the Democratic Party raised its slogan of "from infrastructure to people," and it aimed to reduce tangible expenditures such as public construction and promoted intangible expenditures, such as social security. Discussion about whether this policy direction has been right or wrong aside, the policy certainly provides a good example of an action of government that possibly demonstrates voters' preferences toward government expenditure, and how they might be different depending on whether the spending is used for tangible or intangible programs.

The proportion of elderly voters will increase more than ever, with a corresponding expected increase in the influence of their preferences in political decisions in Japan. Therefore, understanding the positive or negative attitudes of the elderly toward educational expenditures, classified by character, will be a useful factor when local government decision makers discuss how to allocate limited public education resources. As far as we know, in the area of educational policy, there is limited research examining the influence of aging on educational expenditure focusing on its character. In addition, we conduct a detailed analysis by applying dynamic perspective after carefully examining the data's characteristics.

II. Theoretical background and previous research

The impact of aging on educational expenditure is intuitively thought to be negative. That is, if the elderly are assumed to be selfish, there would be support for increases to social welfare related expenditure such as medical expenses in regions where there is aging, and less support for educational expenditure, since it provides little direct benefit for the elderly. On the other hand, as noted in successive previous studies such as Poterba (1998) and Harries et al. (2001), there are five main cases where the elderly are also likely to support increases in educational expenditure.

First, the indirect benefits of positive externalities from education extend across generations, reaching the elderly as well. When young workers improve technology and productivity through education, their wages increase, leading to increased tax revenues, which can be expected to create enrichment of social welfare costs and the like. Second, the elderly might be altruistic. For example, if they benefit from consumption by their children or grandchildren, as in what is more specifically referred to in the retail sector such as the apparel industry and at department stores as "the six pockets," there are cases of relative generosity where the elderly will spend more on grandchildren when the birth rate is low. Third, is the capitalization of the educational impact through an increase in asset value. In this case, if a person planning to purchase a house does not mind spending more to do it in an area with a good school highly evaluating the quality of the school, the elderly will no doubt support an increase in educational expenditure to maximize the asset value. Fourth, is the case of "voting with one's feet" (Tiebout, 1956). In this case, the proportion of elderly determining educational expenditure is an endogenous variable. If elderly persons who are thought unlikely to want to pay taxes to enrich public education expenses move to regions where educational expenditure is low, the educational expenditure in regions with lots of children is likely to remain high despite aging in the region. Fifth is the case that the elderly think that public education is vital for children to adapt to life in society. This could include learning about aspects such as the duties of citizens and social norms through education that reduces the crime rate and stimulates economic activity.

In theory, the relationship between aging and local public educational expenditure can be either positive or negative, and empirical analysis has so far provided no conclusive evidence either way. Many previous results have shown a negative relationship between them (Chart II-1). Ladd and Murray (2001), however, did not find any significant result to confirm this hypothesis. Hoxby (1998) analyzed the impact at the school district level in Massachusetts from 1900 to 1990, showing a positive relationship between aging on public educational spending in the early Twentieth Century. In Japan, Ohtake and Sano (2009) also found a positive relationship between aging and compulsory education expenditure before the 1980s. Miyaki and Kimura (2018) found that before the 1990s, the elderly tended to support local public expenditure especially for the higher educational stages such as high school and university. After the 2000s, however, the cohort's preferences changed, and they have not been so willing to support spending for those educational stages. They even show a statistically significant negative attitude toward local public expenditure for earlier educational stages such as kindergarten and the primary grades.

Chart II-1: Relationship between aging and educational expenses

Previous research	Area	Period	Relationship between aging and educational expenses
Poterba（1997, 1998）	USA・State	1960～1990	−
Hoxby(1998)	"USA・Massachusetts ・School district"	1900～1990	～Beginning of the 20th century：＋ from 1990：−
Ladd and Murray(2001)	USA・County	1970～1990	0
Harris et al.(2001)	USA・School district	1972～1992	−
Grob and Wloter（2007）	"Switzerland ・State／Territory"	1996～2002	−
Borge and Rattso(2008)	Denmark・Local government	1986～1996	−
Arvate and Zoghbi(2010)	Brazil・Local government	1991, 2000	−
Ohtake and Sano(2010)	Japan・Prefecture (Every 5 years)	1975～2005	～1985：＋ 1990～：−
Figlio and Fletcher (2012)	USA・School district	1970, 80, 90	−

Note: ＋ and − indicate positive and negative sign of coefficients of estimated parameters, respectively. 0 indicate "not significant".
Source: Authors.

Those previous studies offer insightful evidence. However, one point of view is not considered: a voter’s preference in cases where expenditure could differ according to character. In the middle of severe financial difficulties and a declining birthrate, the elderly may show a negative attitude toward tangible spending such as new construction or expansion of school facilities, but they may be tolerant of increases in intangible spending that can easily affect the quality of education. On the other hand, perhaps some spending for indispensable projects such as maintaining aging buildings and upgraded earthquake-resistant construction could be spent regardless of the elderly’s preferences.

Some empirical research in the area of local government expenditures has often taken into consideration that point of view, analyzing expenditures by character. For example, Miyazaki (2007) investigates the cost-reduction effect caused by municipal mergers, classifying public expenditures by categories such as current costs and personnel costs. He found a different result for the cost-reduction effect, depending on the character of each expenditure. It is true that the differences in the reduction effect do not always correspond to voter’s preferences, since some expense items are relatively easy to be cut, while others are not due to the rigidities or other characteristics of government spending. It is still possible, however, that government spending reflects a difference of a voter’s preferences. Aoki et al. (2012) investigated compulsory educational expenditures classified by character in Japan and surveys their time-series trend, focusing on the funding source structure and intergovernmental relationships. However, this study only grasps the actual situation without empirically examining the determinants of educational expenditures.

III. The data

Looking at the financial source of educational expenditure, we find local governments which consist of prefectures and municipalities, are playing a greater role than the national government. “Overview of Educational Expense” included in the Ministry of Education, Culture, Sports, Science and Technology’s “Local Educational Expense Survey” reports that the proportion of educational expenditure borne by national and local governments in Japan were 36% and 64%, respectively, in 2013. These proportions consider a local allocation tax (LAT) to be local funds and calculates it by including the appropriated amount of tax allocated by local governments for educational expenditure, as the total expenditure borne by local governments. However, even if the appropriated amount of LAT is considered to be national government funds, the portion borne by local governments remains large and local public bodies have considerable discretion concerning educational expenditures. Thus, we analyze local level of educational expenditure.

Even when referring to educational expenditure as a single item, the coverage of such expenditure is diverse. According to the Ministry of Internal Affairs and Communications’ “Local Public Finance Survey”, educational expenditure can be split into three main categories: school expenses, general and administrative expenses, and social-educational expenses. In FY2014, their respective portions of educational expenditure were 79.2%, 19.1%, and 1.6%, respectively. School expenses refer to the cost of spending on school education activities at the so-called “Article 1 schools,” as defined in Article 1 of the School Education Act (1947), pertaining to levels from kindergarten to university. The direct beneficiaries of such school education are the students enrolled at each education level. General and administrative expenses include the costs required by the Board of Education and executive offices, educational work and private education institutional aid. Social education expenses record the cost of social-educational facilities such as libraries and museums, as well as the cost of social education activities. The direct benefits of general educational expenses and social-educational expenses cover a wide-range, from the students in private schools to users of facilities—including the elderly. Thus, it is difficult to standardize the amount of expenditure according to specific beneficiaries as in the case of school expenses. Therefore, in this paper, we focus on school expenses which account for the lion’s share of local educational expenditure.

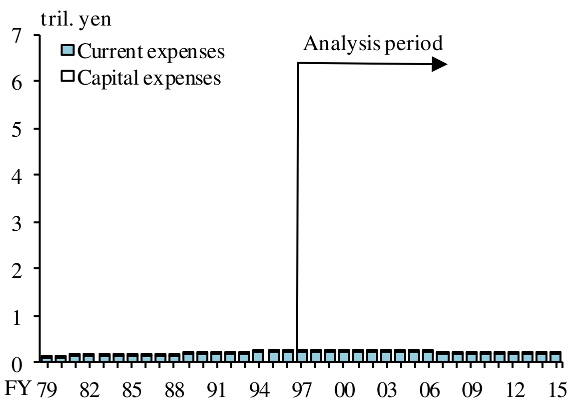
Before we begin the analysis, we overview the expenditure data classified by character. According to “Local Educational Expense Survey,” educational expenditure by local governments can be classified into three categories, that is, current expenditure composed mainly of personnel expenses, capital spending incurred mainly for fixed assets such as school buildings and debt redemption expenses (of local government debt). Since it is reasonable to think that the amount of debt redemption expense is unlikely to reflect a voter’s preference, we decide to analyze current and capital expenditures instead.

In FY2014, the total amount of current and capital expenditure is JPY222 billion for kindergartens, JPY 5,768 billion for primary schools, JPY3,263 billion for junior high schools and JPY2,452 billion for high schools, respectively, marking primary schools the largest recipient of funding among all the stages. Looking at the time-series trend from FY1979, which is the oldest survey year available online, at each educational stage, the amount of educational expenditure had been increasing by the 1980s. The growth rate started to slow down at the dawn of the 1990s and was generally flat during that decade. After that, in the 2000s, kindergarten and primary schools showed a slightly decreasing trend, while junior high schools seemed to be nearly flat. As for high school, a decreasing trend could be identified, but some portion of it (in very recent years) showed an increasing trend（Chart III-1）.

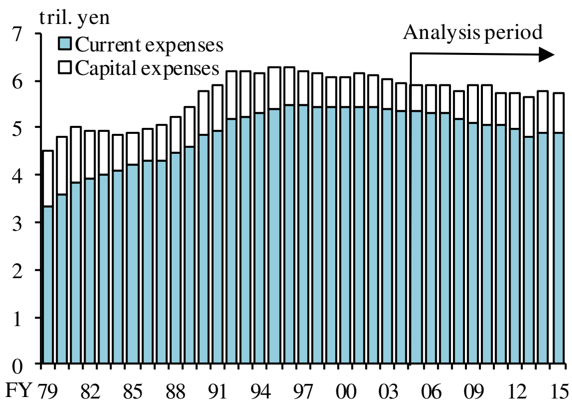
Chart III-1: Public educational expenditure

＜Total＞

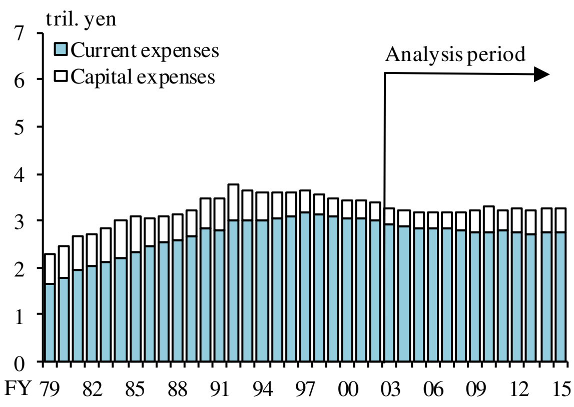
(Kindergarten)



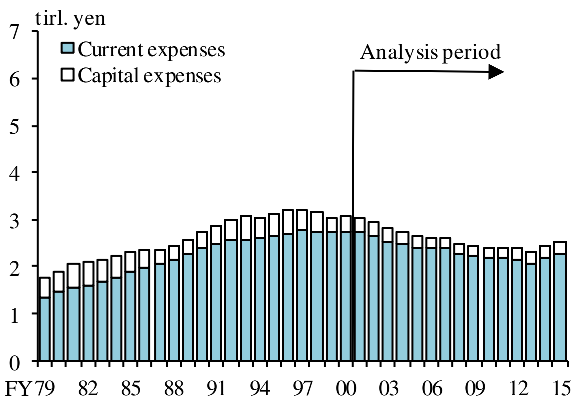
(Primary school)

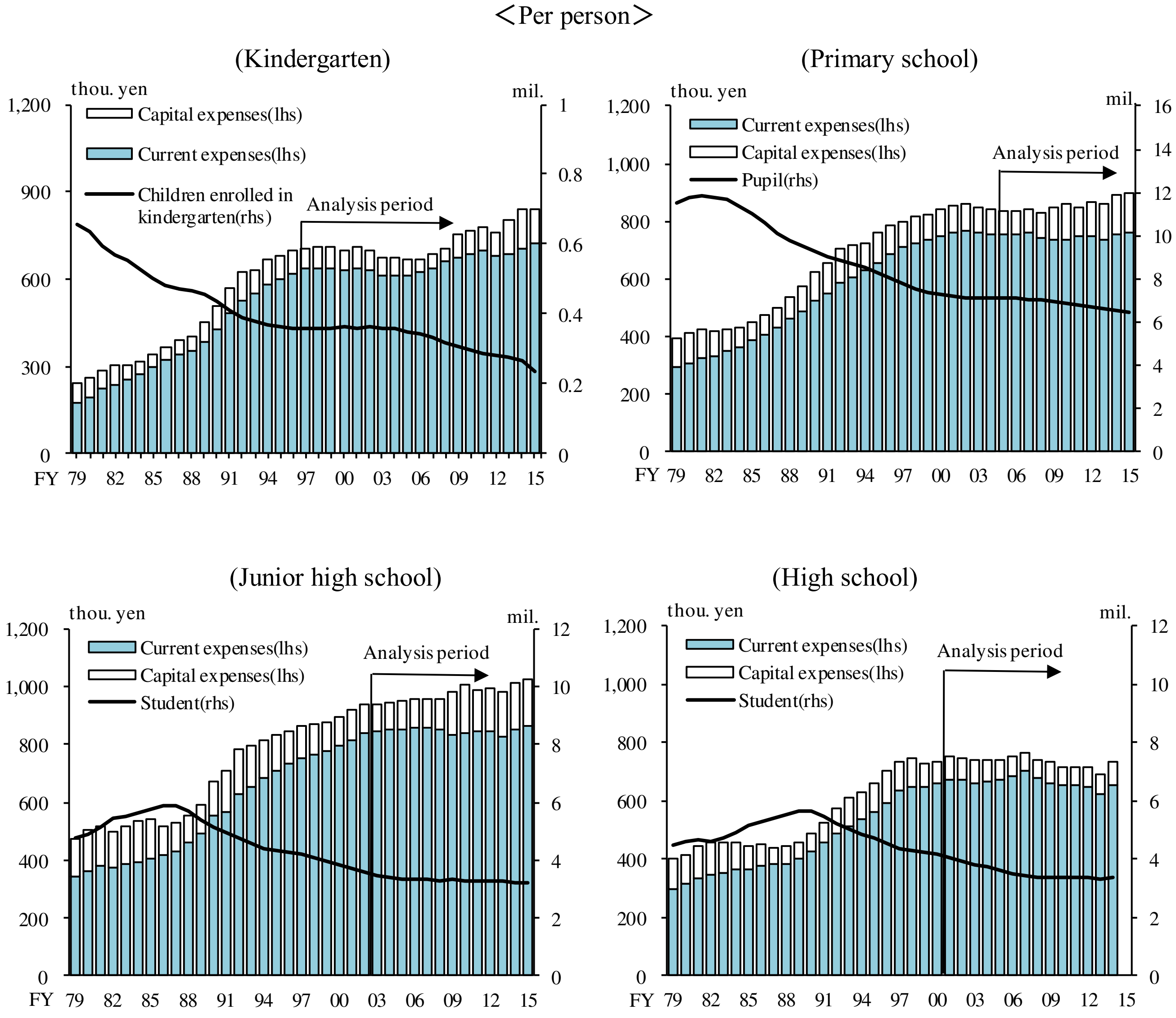


(Junior high school)



(High school)



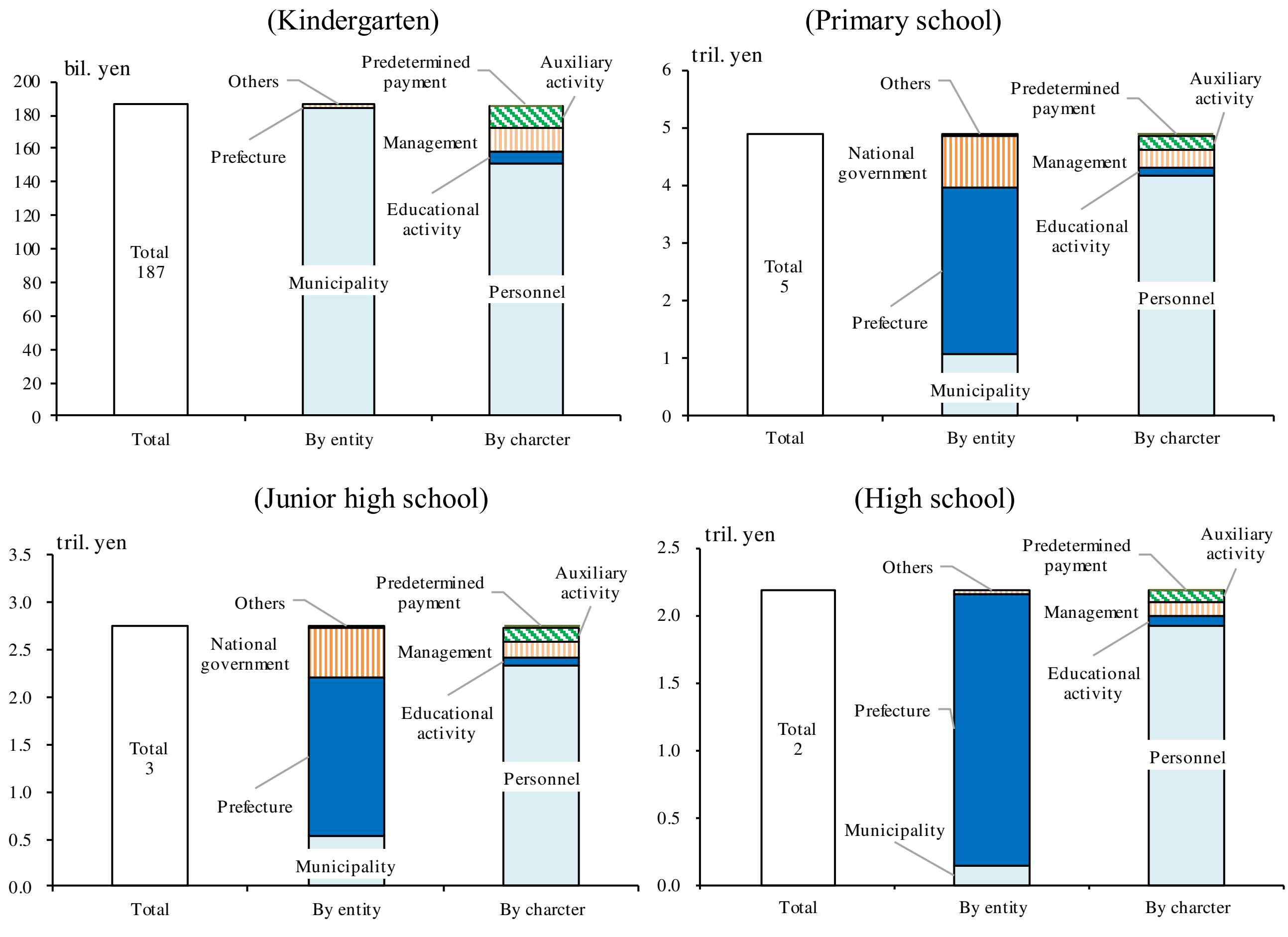


Source: “Local Educational Expense Survey”, “School Basic Survey.”

Educational expenditure per student in FY2014 is JPY0.84 million for kindergartens, JPY0.89 million for primary schools, JPY1.01 million for junior high schools and JPY0.74 million for high schools, respectively, marking junior high school the largest recipient among all stages. As for the number of students, the trend has showed a clear increase during the period of the second generation of baby boomers’ children. Since then, however, it has continued to decline until now. On the other hand, educational expenditure per student had been steadily increasing until the 1990s in all the covered educational stages, implying that schoolroom educational costs per student has been increasing even while the number of children has been decreasing. In the 2000s, the trend showed a slight increase or was substantially flat, only kindergarten expenses per child started to increase again, at least after 2006.

We then look at the situation of current expenditure in detail. （Chart III-2） shows the breakdown of current expenditure by entity and character. According to the chart summarizing character results, almost 80% of the total amount is personnel expense at all educational stages. The other 20% accounts for the costs required for classroom operations, i.e., "educational activities expense" such as education-related consumable materials, special activities, and business trips, along with "management expense," e.g., repairs, security, purchases of consumable supplies, heating, and lighting costs.

Chart III-2: Breakdown of current expenses (FY2014)

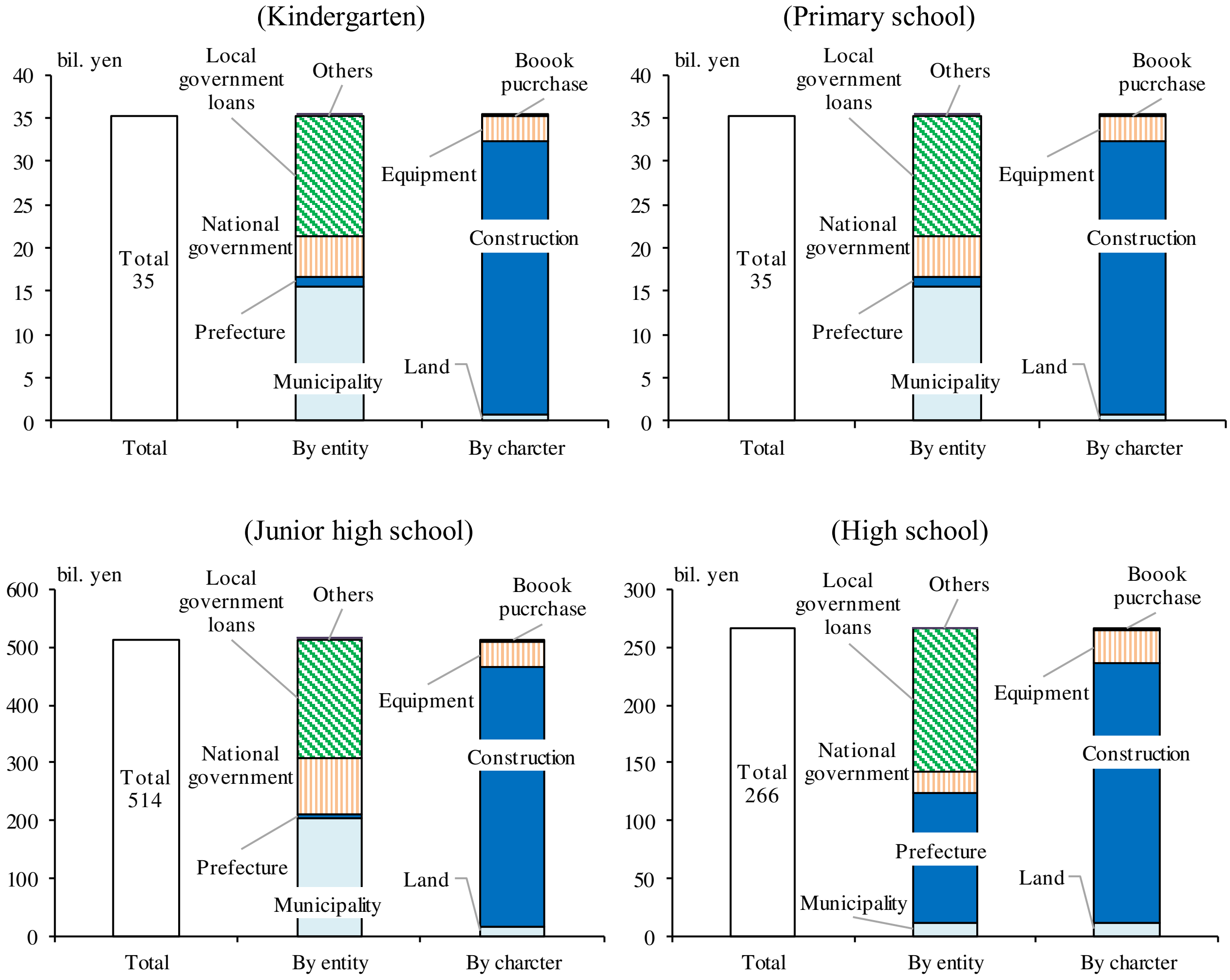


Source: "Local Educational Expense Survey."

Next, we move on to see the main financing entities for each stage of education. Kindergarten and high school have been established and supervised by municipal boards of education and prefecture boards of education, respectively. Therefore, basically, a kindergarten's finance falls under the responsibility of municipalities, while high schools' fall under the responsibility of prefectures. As for primary and junior high schools, although they are established and supervised by municipal boards of education, both prefectures and municipalities finance their budgets. But as （Chart III-3） shows, the share of prefectures is higher than that of municipalities. This is because prefecture boards of education have authority to appoint teachers and other staff, and prefectures are in charge of paying their salaries. In principle, school-related expenditures are supposed to be financed by municipalities, as specified in the Act on Sharing of Salaries for Personnel of Municipal Schools. However, to avoid the possible problem of disparity in educational levels between regions, due to dramatic differences in each one’s relative financial strength, prefectures whose financial power is less heterogeneous than a municipality takes responsibility of paying personnel expenses, which is called the Prefectural Subsidies for Teachers' Compensation System. Because of this system, the burden of current expenditure by a prefecture is larger than that by the municipality at the primary and junior high school levels. Furthermore, under the system of the National Treasury’s Sharing of Compulsory Education Expenses, the national government bears the one-third of teacher and staff salaries, and prefectures bear the other two-thirds, which is also financed by the national government through LAT to the appropriate prefectures. Unlike primary and junior high school stages, national government subsidies for kindergartens and high schools accounts for only about 1% of total local school expenditures. In recent years, however, aligned with the growing demand to support students with special needs at each educational stage, the national government subsidizes a certain portion of costs for local governments that try to develop a favorable support system.

Now we move on to consider the situation of capital expenditure in detail. (Chart III-3) shows the breakdown of capital expenditure by entity and by character for each educational stage. According to the chart by character, “construction expense” occupies the largest share of total expenditures, which are, for example, the cost for extension or reconstruction of school buildings, gymnasiums, and libraries, labor costs for remodeling, material costs, and contracting costs. According to the “Local Educational Expense Survey,” projects like large-scale repairs subject to national subsidies or local bond issuance, e.g., construction for disaster recovery and earthquake resistance, expanding the operational life of facilities and projects that increase the value of facilities are regarded as capital expenditures.

Chart III-3: Breakdown of capital expenses (FY2014)



Source: "Local Educational Expense Survey."

According to the Ministry of Education, Culture, Sports, Science and Technology[3], on April 1, 2017, 98.8% of public primary and junior high schools had completed earthquake-resistant reinforcement of their buildings. In more recent years, it is required to allocate the budget for improvement in educational environment to meet with changes in social situations, e.g., maintenance of aging buildings, equipping structures with air-conditioners, and installing barrier-free facilities.

Looking at the financing entities, the share allocated to municipalities is larger than that of prefectures for kindergarten, primary, and junior high schools, since municipal boards of education have a responsibility to establish and supervise schools. Similarly, high schools are established and supervised by prefecture boards of education, prefectures have a larger share than that of a municipality. Compared with the case of current expenditures, share of local governments' burden is not so large,

[3] Refer to the following website of the Ministry of Education, Culture, Sports, Science and Technology(http://www.mext.go.jp/a_menu/shotou/zyosei/nyuumon.htm).

nearly 50% of total capital expenditures. The other 50% consists of national subsidies and local bonds issued and the share of local bonds issued accounts for about 40% for all educational stages. To provide an equal educational opportunity and improve country-wide educational levels, the national government covers a certain portion of capital expenses for public school facilities, especially for compulsory educational stages. Variance exists among educational levels, although it accounts for nearly 20% in primary and junior high schools, it amounts to only 5% for high schools.

Some previous research that investigated the relationship between aging and public educational expenditure with long-term time-series data showed that the relationship is not always constant through an estimation period and point out the possibility of structural changes during the covered periods. For example, Hoxby (1998) showed that aging and educational expenditures were positively correlated by the turn of the Twentieth Century, but since then that positive impact has declined and eventually became negative in the 1990s. In Japan, Ohtake and Sano (2009) who examined the relationship between aging and compulsory education expenditures using a prefectural level panel dataset every five year from 1975 to 2005 statistically identified that the influence of aging on expenditure changed around 1993. They point out that there was a positive relationship before 1985 but the effect turned negative after 1990. Miyaki and Kimura (2018) also divided the estimation periods into two phases, considering fiscal reforms concerning the intergovernmental relationships.[4] As a result, the negative influence of aging on educational expenditure is more significant in the latter part of the estimation period than in the earlier one, especially for lower educational stages (Chart III-4). As for higher stages, namely high school and university ones, the positive impact of aging on educational expenditure seems to have diminished during the latter part of the period.

[4] For primary and junior high school, they consider a FY2004 fiscal reform of introducing new block-grant system toward the government subsidy for compulsory education and a FY2006 revision of the national treasury's obligatory share of compulsory education expenses. For university they consider FY2004 fiscal reform of turning into independent administrative corporations and apply chow-tests to each data. As for kindergarten and high school stages, since there have not experienced any huge reform deserving special mention and due to some data constraint problems, they apply Supremum-Wald Test that is applicable to the data even when the period of structural change is not specified beforehand.

Chart III-4: Impact of aging by educational stage

Educational stage	Kindergarten		Primary school		Junior high school		High school		University	
Period	～1996	～1997	～2004	2005～	～2002	2003～	～2000	2001～	～2003	2004～
Static model	(−)	−−	−−−	(−)	(−)	−−−	(−)	(−)	+	(−)
Dynamic model	(+)	−−	−−	−−−*	(+)	−−−	+++	(+)*	+	(−)

Note: 1. ＋ and － indicate positive and negative sign of coefficients of estimated parameters, respectively.

2. Parentheses indicate "not significant". + (or -), ++ (or --) and +++ (or ---) indicate each coefficient is significant at 10%, 5% and 1%, respectively.

3. * indicates that Hansen-J statistic shows some instrument variables might not be exogenous.

4. Dynamic model applies Arellano Bond model.

Source: Miyaki and Kimura (2018).

Based on the aforementioned results in Miyaki and Kimura (2018), it seems that the elderly start to show a rather passive attitude toward educational expenditure in recent years than they used to be. Thus, in this paper, we focused on the latter part of the estimation period and conducted a character-wise analysis for each educational stage. In other words, at each stage, we explored what specific character of educational expenditures the elderly were unwilling to support. Doing so was also important from a public interest viewpoint in policy making, so that one may grasp recent trends in the elderly's preferences. The specific estimation period is from 1997 to 2014 for kindergarten, from 2005 to 2014 for primary schools, from 2003 to 2014 for junior high schools and from 2001 to 2014 for high schools. Note that we did not examine university education, since we cannot obtain university expenditure data by character due to data constraints.

IV. The analysis

1. Estimation model

First, we conduct a statistical test to check stationarity of the independent and dependent variables. Specifically, we apply the LLC test (Levin, Lin and Chu, 2002) and the IPS test (Im, Pesaran and Shin, 2003) to the data, along with the Fisher-type test (Maddala and Wu, 1999) to unbalanced panel data. To show the difference among those tests, we consider an AR(1) model as follows. Here i indicates prefecture and t indicates time. In all the tests, null hypothesis is that there is a unit root.

$$y_{it} = \alpha_i + \gamma_i t + \rho_i y_{it-1} + \varepsilon_{it}$$

The LLC test assumes that a variable takes the same value for all prefectures both in the null and the alternative hypotheses and that $\rho_i < 1$ in the alternative hypothesis

$$\text{H0: } \rho_i = 1 \quad \text{for all } i \ (i = 1, 2, \dots, 47)$$

$$\text{H1: } \rho_i < 1 \quad \text{for all } i \ (i = 1, 2, \dots, 47)$$

On the other hand, IPS test loses the assumption of the alternative hypothesis that ρ_i is the same among all i.he value of ρ_i can be varied among each i, assuming $\rho_i < 1$ at least in one prefecture.

$$\text{H0: } \rho_i = 1 \quad \text{for all } i \ (i = 1, 2, \ldots, 47)$$
$$\text{H1: } \rho_i < 1 \ \text{ for } \ i \quad (i = 1, 2, \ldots, N), \ \rho_i = 1 \ \text{ for } \ i \quad (N, N+1, N+2, \ldots, 47)$$

Finally, a Fisher-type test sets the same assumptions as an IPS test, but it applies a unit root test (ADF test or Phillips-Perron test) to individual i. The null hypothesis is examined using test statistics calculated by tallying up the obtained p-values. We confirmed that all the variables become stationary after taking the first difference.

The analysis in this paper is based on the following model.

$$y_{i,t} = \rho y_{i,t-1} + \beta pop65_{i,t} + X_{i,t}\boldsymbol{\delta} + \gamma YEAR_t + \alpha_i + u_{i,t}$$

Here $y_{i,t}$ indicates the educational expenditure (current expenditure or capital expenditure) per student enrolled at each educational stage in i prefecture for fiscal year t. To analyze the amount of educational expenditure over which local governments have discretion, we subtracted the amount of national subsidy per student from current and capital expenditure per student spent by prefectures and municipalities and set them as dependent variables.

$y_{i,t-1}$ is the lagged dependent variable to take into consideration the dynamic behavior of the local government. If the behavior of local public bodies was dynamic and the lag term of the dependent variable were not taken into account, the error term would be correlated with the dependent variable and the estimation results would be biased. So, we thought that dynamic models that consider past expenditure should be included in the first step of the analysis and, therefore, in this paper we applied dynamic panel analysis.

Many previous studies suggested the dynamic behavior of government expenditure. Portrafke (2010) analyzes the relationship between state government expenditure allocation and government ideology in West Germany, applying a dynamic panel model for its robustness check. Kapper and Vallia (2008) points out that the fiscal expenditure as dependent variable tends to have strong autocorrelation. Jia, et al. (2014) analyzes the influence of the decentralization progress of local governments on local fiscal expenditure, and also adopts a dynamic model to consider heterogeneity of local governments and adhesion to government expenditure. According to the results of the empirical analysis, Dahlberg and Johansson (2000) which analyzed municipal expenditure and revenue in Sweden, found the one-year lagged dynamic behavior within the local public sector, and Bergström, et al. (2004) also pointed out the importance of considering such behavior by local government. As a result of attempting to replicate Dahlberg and Johansson (2000)'s analysis, Takahashi (2013) also pointed out that past expenditure still affected current spending. In Japan, many previous studies such as Akai, et al. (2003) suggest the possibility of soft budget constraints existing in the LAT system. For example, Miyazaki (2007) pointed out that previous expenditure affected "the correction factor” in the process of LAT calculation, and under such circumstances local governments anticipate future national government relief in determining their current expenditure. In other words, past expenditure may have an effect on present expenditure, and it is necessary to consider the dynamic behavior of the local governments.

$pop65_{i,t}$ indicates the ratio of population aged 65 and older, and β is the estimated parameter. To deal with the possible endogeneity problem of the aging ratio, we considered the five-year lagged aging ratio as an instrument variable which is a real value obtainable from National Census. $X_{i,t}$ indicates the other independent variables that affect educational expenditures and $\boldsymbol{\delta}$ is the vector of the estimated parameter. As for $X_{i,t}$. we consider the following independent variables, i.e., the ratio of the potential demander at each educational stage to the total population,[5] the national subsidy per student, the number of schools in each educational stage, per capita income and a financial capability indicator. The data for per capita income and the financial capability indicator represent for the regional economy’s level and local governments’ financial situations, respectively. $YEAR_t$ indicates a trend term that eliminates the influence of macroeconomic shock on educational expenditures, α_i indicates unobservable heterogeneity of prefectures unchanged over time, and $u_{i,t}$ indicates a stochastic error term. All variables are logarithmically transformed. Note that price data is deflated using the GDP deflator and transformed into its natural logarithm. As for descriptive statistics of the variables, refer to（Chart Ⅳ-1）

[5] We calculated the number of the potential demander for each educational stage as follow. We can obtain one-year age data from the national census that is surveyed in every five years. We can also obtain five-year age group data every year from National Institute of Population and Social Security. At the timing when national census is taken, we calculate division ratio of age group that corresponds to the potential demander of each educational stage. Then, assuming that the division ratio will be constant by the year when next census is surveyed in coming five years, we calculate the potential number of demander using the ratio.

Chart Ⅳ-1: Descriptive statistics

（Kindergarten）＜FY1997～2014＞

Variable	Sample	Unit	Average	Std. dev	Min	Max
Dependent variable						
Current expenditure per child	846	yen	681,855	159,800	338,905	1,486,413
Capital expenditure per child	846	yen	64,062	70,879	877	725,066
Independent variable						
National government disbursement per child (Current)	846	yen	5,658	21,960	0	352,975
National government disbursement per child (Capital)	846	yen	9,382	15,814	0	162,119
Ratio of a population aged 3 to 5	846	%	2.69	0.27	1.94	3.96
Ratio of a population aged 65 and older	846	%	22.12	3.87	11.04	32.69
Number of public kindergaten	846		117	105	2	560
Income per population	846	yen	2,797,896	481,541	1,901,008	5,431,468
Financial capability indicator	846		0.46	0.20	0.20	1.41

（Primary school）＜FY2005～2014＞

Variable	Sample	Unit	Average	Std. dev	Min	Max
Dependent variable						
Current expenditure per pupil	470	yen	665,737	89,972	469,494	944,719
Capital expenditure per pupil	470	yen	89,249	36,134	20,522	240,978
Independent variable						
National government disbursement per pupil (Current)	470	yen	163,471	25,942	104,390	266,068
National government disbursement per pupil (Capital)	470	yen	32,754	20,906	4,230	117,180
Ratio of a population aged 6 to 11	470	%	5.47	0.41	4.41	7.47
Ratio of a population aged 65 and older	470	%	24.29	2.98	15.91	32.69
Number of public primary school	470		463	279	134	1,401
Income per population	470	yne	2,896,047	485,385	2,011,684	5,431,468
Financial capability indicator	470		0.48	0.20	0.21	1.41

（Junior high school）＜FY2003～2014＞

Variable	Sample	Unit	Average	Std. dev	Min	Max
Dependent variable						
Current expenditure per student	564	yen	707,673	110,611	468,648	1,140,962
Capital expenditure per student	564	yen	108,535	53,231	18,954	438,279
Independent variable						
National government disbursement per student (Current)	564	yen	201,317	39,356	130,006	414,974
National government disbursement per student (Capital)	564	yen	36,709	26,860	124	219,820
Ratio of a population aged 12 to 14	564	%	2.88	0.21	2.21	3.97
Ratio of a population aged 65 and older	564	%	23.73	3.18	15.04	32.69
Number of public primary school	564		214	137	60	724
Income per population	564	yne	2,873,287	487,256	2,004,735	5,431,468
Financial capability indicator	564		0.47	0.20	0.20	1.41

（High school）＜FY2001～2014＞

Variable	Sample	Unit	Average	Std. dev	Min	Max
Dependent variable						
Current expenditure per student	658	yen	737,450	110,136	440,080	1,040,681
Capital expenditure per student	658	yen	74,715	46,841	9,956	355,034
Independent variable						
National government disbursement per student (Current)	658	yen	1,331	5,021	0	65,716
National government disbursement per student (Capital)	658	yen	9,123	17,237	0	139,183
Ratio of a population aged 15 to 17	658	%	3.16	0.36	2.22	4.63
Ratio of a population aged 65 and older	658	%	23.21	3.38	13.70	32.69
Number of public high school	658		83	51	24	282
Income per population	658	yen	2,842,341	487,858	1,982,184	5,431,468
Financial capability indicator	658		0.46	0.20	0.20	1.41

As mentioned before, when the first difference of each variable is taken, the null hypothesis is rejected at a 1% significance level and stationary data is obtained. In this chapter, we estimate the following model. The individual effect α_i is eliminated in this difference model.

$$\Delta y_{i,t} = \rho \Delta y_{i,t-1} + \beta \Delta pop65_{i,t} + \Delta X_{i,t}\boldsymbol{\delta} + \gamma YEAR_t + \Delta u_{i,t}$$

Since the logarithm difference is taken, the above equation captures movement in the rate of change. However, as $\Delta y_{i,t-1}$ and $\Delta u_{i,t}$ are correlated with each other, the consistency of the estimator is satisfied neither in the normal fixed-effect model nor the generalized least squares model. In order to solve this problem, we use an estimation method based on first-difference generalized momentum method (GMM) (Arellano and Bond <1991>, hereinafter call A-B model).

As another dynamic model, Anderson and Hsiao (1982)'s two-step least squares method (hereinafter called the A-H model) and the like may be cited, but there are advantages and disadvantages of using this method depending on the characteristics of the sample size. The A-H model is a method for calculating a consistent estimator by sing instrumental variables. The A-B model is a method for calculating a consistent estimator by the GMM. According to Takahashi (2013), in case of data having a sufficiently large cross-sectional data and a sufficiently small time-series one, the GMM estimator in the A-B model is more effective than the estimator under a two stage least squares method of the A-H model. In the A-B model, the GMM objective function is defined by using the following moment condition and an unknown parameter is estimated by instrumental variables satisfying $y_{is}, s \leq t-2$.

$$E\left[y_{i,s}\Delta u_{i,t}\right] = 0, t = 2, \dots, T,\ s = 0, \dots, t-2$$
$$E\left[\Delta x_{i,s}\Delta u_{i,t}\right] = 0, t = 2, \dots, T,\ s = 1, \dots, T$$

According to Binder, Hsiao and Pesaran (2005) and Hsiao, Pesaran and Tamischiouglu (2002), the increase of the lag period as instrumental variables in the GMM estimation could lead to finding a more effective estimator, but imposing too many orthogonal conditions yields problems and, empirically, downward bias also increases. The term of this analysis data is at least ten years, even in the primary school dataset (which has the shortest period), and if the lag period(s) of $y_{is}, s \leq t-2$ as an instrumental variable is not specified, the number of instrumental variables becomes very large. Empirically, it is desirable that the number of instrumental variables is smaller than the number of cross-section individuals. Therefore, in this paper, we take a method of considering higher order lag period additionally when the two lags of the endogenous variable are taken as the instrumental variable (s = 2) and they do not satisfy the orthogonal condition of the instrumental variable.

In both models, obtaining a consistent estimator without serial correlation in the error term is an important assumption underlying GMM estimation. In this paper as well, we test serial correlation against the error term of the first difference. If the first-order autocorrelation is significant and the second-order autocorrelation is not significant, the original error term can be said to be uncorrelated.

2. Estimation results and interpretation

Detailed results of estimations and tests are shown in the "reference table," while a brief version that only summarizes the effects of aging is shown in Chart IV-2. We also show the estimation results of static model for reference which does not consider the lagged dependent variable. Note that we deal with the possible endogeneity problem of the aging ratio in the static model, too.

Chart IV-2: Estimation Results (A brief version)

Educational stage	Kindergarten		Primary school		Junior high school		High school	
Character	Current	Capital	Current	Capital	Current	Capital	Current	Capital
Static model	(−)	(−)	(+)	(+)	−	(−)	(+)	(+)
Dynamic model	−−	(−)	−−−	(+)	−−−	+	−	+

Note: 1. ＋ and － indicate positive and negative sign of coefficients of estimated parameters, respectively.
2. Parentheses indicate "not significant". + (or -), ++ (or --) and +++ (or ---) indicate each coefficient is significant at 10%, 5% and 1%, respectively.
3. Dynamic model applies Arellano Bond model.
Source: Authors creation.

Hereafter, we mainly discuss the results obtained through the dynamic panels that incorporates the dynamic behavior of local governments. According to Miyaki and Kimura (2018), aging showed a negative and significant correlation with educational expenditures of kindergarten, primary, and junior high schools in the covered period, as shown in Chart III-4. As a result of the estimations by character conducted, current expenditures were found to have negative correlations with aging in any of the estimates. As for high schools, although estimates using the total amount of expenditures showed insignificant results in Miyaki and Kimura (2018), through estimations by character, current expenditures showed a negative and significant relationship with aging as well as with the results obtained at other educational stages. Based on the foregoing results, a recent trend can be identified that the elderly are not likely to support an increase in current expenditures wherein personnel costs constitute a considerable fraction, at any educational level. The effect of aging on capital expenditure was not statistically significant at the kindergarten and primary school stages. However, it was a positive and significant for junior high and high school ones, which came out with the opposite result through the estimates of current expenditure. One might point out that an aging population supports such capital expenditure, which consists of construction costs mostly. The coefficient obtained from the estimation at primary schools was also positive, although the result was not statistically significant.

We would like to briefly discuss the results of other independent variables. Lagged educational expenditure turned out to be positive and significant in general, which suggested possible dynamic behavior of local governments. In greater detail, current expenditure showed a positive coefficient at the 1% significance level for primary, junior high, and high schools, while capital expenditure showed a positive coefficient at the 1% significance level at kindergarten and high school levels alone, being less significant but still positive at the primary school level, and insignificant at the junior high school one. The national subsidy showed different results depending on the character of the expenditure. Specifically, its effect on the current expenditure was negative and significant for primary, junior high, and high schools, while its effect on capital expenditure was positive and significant at kindergarten, primary, and junior high schools. The national subsidy is supposed to have a positive correlation with local expenditure inherently, since it is a grant that the national government provides to local municipalities in order to encourage them to implement specific administrative projects. Despite the above-mentioned original purpose, national subsidies were found to have a negative relationship with current expenditures.

As one possible reason for the results in the primary and junior high school cases, we consider it would be attributed to the fiscal relationship between the national government and prefectures on personnel cost that constitutes a considerable fraction of current expenditures. When a prefecture is driven to reduce the number of teachers and staff, or their salaries, for some reason, such as fiscal constraint, and as a consequence the amount spent on payroll falls below the base amount mandated by the national government, it will receive the reduced amount of the national subsidy that covers one-third of total personnel costs. But the remaining two-thirds remains as the amount distributed through the LAT in the general-purpose budget. Hence, when the prefecture in question spends more on other education-related expenditures other than payroll, in excess of the reduced payroll for teaching staffs, a negative relationship between the national subsidy granted and local governments' current expenditures were observed. As another possibility might be related to a recent new movement that can be seen in the situation of financing entity at the primary and junior high school stages. In FY2003, a new system wherein municipalities may employ teachers and staffs with their own general budgets was introduced as a trial in designated structural reform districts. Since the Act on Sharing of Salaries for Personnel of Municipal Schools was amended in FY2006, this system has applied to all municipalities across the country. By increasing municipal discretion, the number of teachers and other staff hired with a municipality's own financial resources has been increasing. Kawakami (2015) conducted a detailed survey about the structure of teachers and staff in public primary and junior high school in the Saga prefecture pointed out evidence that the appointment of teachers and staffs by municipalities—i.e., part-time teachers, morals tutors, and school staff for students with special needs and food service operations has been on the rise. Considering such a situation, even when a prefecture reduces salaries which leads to reducing the national subsidy, municipalities may employ teachers and staffs complementally with their own financial resources to sustain and improve the quality of education. As a result, local governments' total amount available for current expenditure is boosted. This kind of employment by municipal governments on their own would be affected, for example, by the fiscal treatment under them. That is, toward the employment of school staffs in charge of special support education, local governments' fiscal treatment regarding the recruitment of assistant staff for special support education has been started for kindergarten from FY 2009, for primary and junior high schools from FY 2007, and for high schools from FY 2011, respectively.

The number of schools were not statistically significant except for the capital expenditure for kindergarten and the current expenditure for high schools. The potential number of demanders had statistically significant, positive coefficients for current expenditures on primary and junior high schools and on capital expenditures for junior high and high schools, while no economies of scale could be confirmed when estimations were conducted by character. Per capita income showed a positive sign that was statistically significant except for current expenditures for preschools. Hence, educational expenditures in the municipalities with robust economic conditions have a high tendency to be increased regardless of the purpose for doing so.

The financial capability indicator showed mixed results for the different educational stages in Miyaki and Kimura (2018), where they turned out to have positive and significant coefficients for current expenditure and negative and significant coefficients on capital expenditure when estimations by character were conducted. As Auchi (2016) pointed out[6], the recent trend is for municipalities that are rich in financial resources to be likely to employ part-time teachers, proactively utilizing the expanded discretion of local governments as explained in Chapter 3, Section 2. Although the result that indicated that financially rich municipalities would increase their current expenditures was well assumed in advance, it could have also been influenced by the administration reform of the incorporation of national universities in FY 2004. The salary of local public officers used to be confirmed to be similar to that of national public officers due to a stipulation in the Special Act for Education Personnel (Act No. 1 of 1949). This stipulation, however, has been removed since teaching staff found in national schools became nonpublic officers in conjunction with the incorporation of national universities, making the salaries of the teaching staffs of public schools came determined through prefectural ordinances (according to the Article 13 of the Special Act for Education Personnel). Through this change, we see that personnel costs, which constitute 80 % of current expenditure, came to be more influenced by the fiscal situation of local governments.

V. Conclusion

The aged population has been increasing its share of qualified voters and its influence in the political decision-making process in Japan where the population is rapidly aging. Bearing this situation in mind, it is increasingly important to consider how the allocation of government expenditure will be expected to be allocated by investigating the preferences of the elderly population with respect to government

[6] He points out that one of the characteristics of municipalities which employ part time teachers with their own financial resource is high financial capability indicator.

expenditures. This paper investigates the preferences of the elderly with respect to educational expenditures and further examines it in detail by conducting educational stage-wise and character-wise estimations, so as to provide material with which administrative staff in local governments can refer when they discuss how to allocate the limited financial resources designated for public education.

According to the estimation results of this paper, the elderly population would not support an increase in current expenditures but would support capital expenditures, judging from data on educational expenditures after the latter half of the 1990s, during which period the aging factor would have been likely to have had a negative relationship with educational expenditure, and we thus conducted character-wise estimations. This result highlights the preferences of the elderly population that restrain expenditures for consumption purposes including payroll, but support expenditures for capital goods including buildings amidst an accelerating aging population. A decrease in educational expenditures, especially in payroll, might lead to the deterioration in educational quality over the long run. However, local governments does not just decrease payroll costs when looking carefully at the contents of current expenditure. As we stated earlier, local municipalities have been gradually given discretion over the employment types of teaching staffs, etc., thus financially rich cities, villages and townships would deal with the deterioration problem on their own by employing part-time teaching staffs or other school staff members.

On the other hand, capital expenditure has a positive relationship with aging. This result suggests the elderly mainly support construction expense which results in tangible infrastructures. Based on capitalization theory, such infrastructures cause the appreciation in asset value which might be leading to the elderly's positive attitude toward capital expenditure. But, it's important to note that contents of construction expense have been changed from construction, expansion, and renovation of buildings, through reinforcement of buildings against earthquakes, to installment of air-conditioners and barrier-free facilities etc. in response to the recent needs for improvement of educational environments.

In the future research, it is expected to investigate factors which affect the preferences of the elderly. Although this paper only covered public educational expenditures due to data limitations, we must also further discuss what a society-wide optimum might look like in terms of educational expenditure, by conducting a comprehensive analysis that utilizes private educational expenditures, including subsidies to private schools, as well as household expenditure.

【Reference Table】

Estimation result (Kindergarten)

Model Character	Static Current		Static Capital		Arellano - Bond Current		Arellano - Bond Capital	
Ratio of a population aged 65 and older	-0.439		-7.035		-0.757	**	-0.691	
	(0.315)		(4.390)		(0.320)		(2.097)	
Kindergarten expenditure per child (t-1)					0.158		0.263	***
					(0.177)		(0.047)	
National government disbursement per child	0.009	***	0.358	***	0.008		0.404	***
	(0.003)		(0.024)		(0.005)		(0.030)	
Number of public kindergaten	0.004		1.936	***	-0.02		1.527	**
	(0.054)		(0.421)		(0.069)		(0.683)	
Ratio of a population aged 3 to 5	-0.378	**	1.629		-0.243		-2.208	
	(0.182)		(2.601)		(0.329)		(1.671)	
Financial capability indicator	0.090	**	-1.308	**	0.086	**	-0.795	**
	(0.045)		(0.645)		(0.037)		(0.313)	
Income per population	0.067		1.924	**	0.001		2.855	***
	(0.066)		(0.796)		(0.078)		(0.736)	
Year	0.000		0.012	**	0.036	***	0.004	
	(0.000)		(0.005)		(0.009)		(0.073)	
Constant term	0.158		-23.86	**				
	(0.833)		(10.65)					
Obs.	846		842		846		840	
R-squared	0.052		0.322					
Kleibergen-Paap rk LM statistic	119.924	***	121.184	***				
Test of AR(1)					-2.29	***	-5.27	***
Test of AR(2)					0.67		0.41	
Hansen J statistic (p-value)	just identified		just identified		0.988		0.995	

Estimation result (Primary school)

Model Character	Static Current		Static Capital		Arellano - Bond Current		Arellano - Bond Capital	
Ratio of a population aged 65 and older	0.119		2.783		-0.714	***	1.130	
	(0.260)		(1.981)		(0.129)		(0.738)	
Kindergarten expenditure per pupil (t-1)					0.364	***	0.131	*
					(0.052)		(0.066)	
National government disbursement per pupil	-0.121	***	0.350	***	-0.190	***	0.345	***
	(0.022)		(0.024)		(0.022)		(0.035)	
Number of public primary school	-0.042		(0.047)		0.057		0.138	
	(0.118)		(0.762)		(0.098)		(0.474)	
Ratio of a population aged 6 to 11	0.438	***	0.622		0.647	***	-0.792	
	(0.153)		(1.081)		(0.157)		(0.865)	
Financial capability indicator	-0.060		-1.100	***	(0.038)		-1.322	***
	(0.052)		(0.391)		(0.044)		(0.185)	
Income per population	0.360	***	0.754	**	0.301	***	1.399	***
	(0.049)		(0.319)		(0.056)		(0.227)	
Year	-0.005	***	0.010		0.030	***	-0.011	
	(0.001)		(0.006)		(0.003)		(0.025)	
Constant term	11.030	***	-21.85					
	(2.268)		(13.51)					
Obs.	470		470		470		470	
R-squared	0.438		0.360					
Kleibergen-Paap rk LM statistic	50.141	***	50.763	***				
Test of AR(1)					-3.51	***	-4.85	***
Test of AR(2)					0.96		0.72	
Hansen J statistic (p-value)	just identified		just identified		0.331		0.196	

Estimation result (Junior high school)

Model Character	Static Current		Static Capital		Arellano - Bond Current		Arellano - Bond Capital	
Ratio of a population aged 65 and older	-0.390	*	-0.163		-0.804	***	1.421	*
	(0.219)		(2.043)		(0.151)		(0.833)	
Junior high school expenditure per student (t-1)					0.459	***	0.069	
					(0.063)		(0.054)	
National government disbursement per student	-0.179	***	0.335	***	-0.277	***	0.336	***
	(0.026)		(0.023)		(0.023)		(0.026)	
Number of public junior high school	0.173		1.637		0.132		0.649	
	(0.135)		(1.108)		(0.161)		(1.093)	
Ratio of a population aged 12 to 14	0.164	***	0.461		0.103	*	0.839	*
	(0.050)		(0.471)		(0.057)		(0.444)	
Financial capability indicator	0.020		-0.206		-0.040		-1.063	***
	(0.039)		(0.384)		(0.047)		(0.210)	
Income per population	0.352	***	0.547		0.364	***	1.003	***
	(0.046)		(0.361)		(0.052)		(0.334)	
Year	-0.004	***	0.015	***	0.023	***	0.001	
	0.000		(0.004)		(0.004)		(0.021)	
Constant term	8.834	***	-31.40	***				
	(1.286)		(8.794)					
Obs.	564		564		564		564	
R-squared	0.488		0.326					
Kleibergen-Paap rk LM statistic	71.711	***	66.868	***				
Test of AR(1)					-4.47	***	-4.22	***
Test of AR(2)					2.07		1.19	
Hansen J statistic (p-value)	just identified		just identified		0.413		0.461	

Estimation result (High school)

Model Character	Static Current		Static Capital		Arellano - Bond Current		Arellano - Bond Capital	
Ratio of a population aged 65 and older	0.174		3.176		-0.157	*	2.935	*
	(0.194)		(2.730)		(0.086)		(1.503)	
High school expenses per student (t-1)					0.484	***	0.227	***
					(0.055)		(0.077)	
National government disbursement per student	-0.005	*	0.0168		-0.008	*	0.029	
	(0.002)		(0.020)		(0.004)		(0.027)	
Number of public high school	0.147	***	0.862		0.196	***	0.808	
	(0.050)		(0.738)		(0.059)		(0.616)	
Ratio of a population aged 15 to 17	0.156	***	0.876		-0.016		1.300	***
	(0.046)		(0.605)		(0.034)		(0.470)	
Financial capability indicator	0.111	***	-0.518		0.116	***	-0.482	
	(0.030)		(0.402)		(0.023)		(0.331)	
Income per population	0.197	***	0.839		0.322	***	1.151	**
	(0.043)		(0.529)		(0.045)		(0.472)	
Year	-0.002	***	0.006		0.006	***	(0.040)	
	0.000		(0.004)		(0.002)		(0.036)	
Constant term	4.040	***	-12.41					
	(0.761)		(9.245)					
Obs.	658		658		658		658	
R-squared	0.133		0.032					
Kleibergen-Paap rk LM statistic	93.889	***	89.62	***				
Test of AR(1)					-4.09	**	-4.9	***
Test of AR(2)					-0.07	*	0.83	
Hansen J statistic (p-value)	just identified		just identified		0.791		0.902	

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