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NEW EVIDENCE ON INCOME DISTRIBUTION AND ECONOMIC GROWTH IN JAPAN

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New evidence on income distribution and economic growth in Japan

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Abstract

There have been many theoretical and empirical researches on the effects of income distribution on economic growth. This paper uses Japanese prefectural panel data to empirically analyze how income distribution affects economic growth.

Four measures of the income distribution are used in the system GMM estimations. The Gini indices, income share of the third quintile and the ratio of the income share of the top decile and the 5^{th} decile show that income inequality has negative effects on growth. The ratio of the income share of the bottom decile and the 5^{th} decile does not have statistically significant effects. Therefore, the estimation results show that the increased income inequality in recent Japan decreased the economic growth.

JEL Classification Codes: O40, C33, J01

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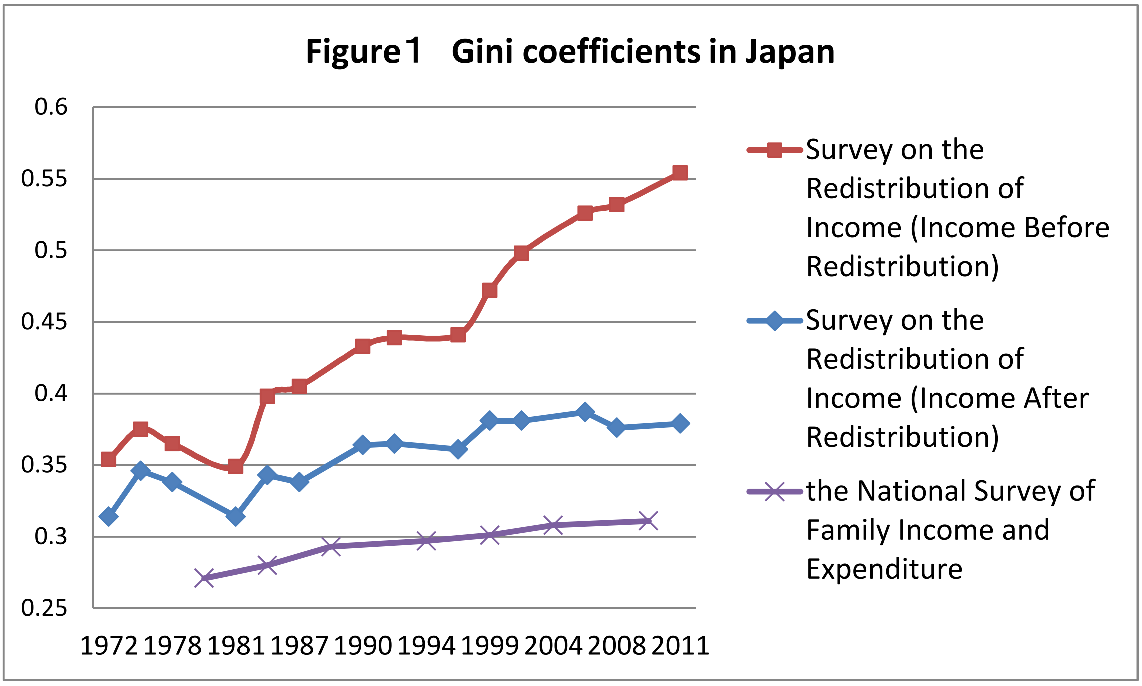
1. Introduction

On the relationship between income distribution and economic growth, there have been many theoretical and empirical researches. About the theoretical researches, income inequality decreases economic growth through the following three channels, according to Weil (2013) and Halter et.al. (2014). First, income inequality inhibits economic growth by fiscal policy and less redistribution because more redistribution or higher tax decreases the efficiency of the economy (Perotti 1993, Alesina and Rodrick 1994, Persson and Tabbelini). Secondly, inequality and capital market imperfection decreases human capital accumulation, because households who are liquidity-constrained decrease their spending on educations (Galor and Zeira 1993, Galor and Moav 2004). Thirdly, inequality decreases the political stability and makes it harder to make expectations on future economic policies (Benabou 1996).

On the other hand, inequality can affect growth positively by increasing savings and the accumulation of physical capital, because people with higher income have higher savings rate. (Weil 2013, Kuznets 1955, Kaldor 1955). In addition, inequality can enhance the realization of high-return projects (Rosenzweig and Binswanger 1993) and increase R&D (Foellmi and Zweimullwe 2006), which enhances economic growth. Therefore, the effects of income distribution on growth have both signs and the overall effect is an empirical problem.

In recent Japan since 1980, statistics such as the Gini indices showed that inequality increased, and active discussion on this possibility of the increase in income inequality was conducted (Otake 2005, Tachibanaki 2004, 2006). It is indicated that about half of the increase in the Gini indices was caused by the population aging and the increase of households with only one or two persons, but consumption inequality within the same generations was also observed, and it indicates income inequality increased to some extent (Ohtake 2005). Also, the increase of inequality people felt became social problem for several years, and recent increase of the maximum rate for income taxes and the increase of inheritance taxes can be considered as the increase of government's income redistribution. Such increase or decrease in income inequality can affect economic growth, and that effect is estimated in this research with Japanese regional data for the first time, to the best of my knowledge.



In figure 1, the transition of the Gini index from two major surveys in Japan are shown. The red line shows the Gini index on the income before redistribution in the Survey on the redistribution of income, and it has been increasing sharply. However, the Gini index on the income after redistribution in the same Survey shown by the blue line increased more slowly during 1980-2002 and did not show constant increase after 2003. Also, if we look at the violet line which shows the Gini index of the pretax income in the National Survey of family income and expenditure, it is lower but increasing since 1979.

In the existing empirical researches, the estimated effects of income distribution on economic growth are different, depending on data and the estimation methods. Lately, Deininger and Square's (1996) panel cross-country dataset and regional panel data within one country are widely used in the empirical researches. While most cross-country studies found a negative relationship between income inequality and economic growth, Forbes (2000) and Li and Zou (1998) used Deininger and Square's panel data and found positive relationship between inequality and growth.

Weil (2013) explains the reason why it is difficult to find out the effect of income distribution on economic growth is that the effect may depend on a county's stage of growth, as well as other factors such as whether a country is open to capital flows from abroad. Actually, Barro (2000) found that inequality increases growth within rich countries, but inhibits it in poorer countries.

Recently, Panizza (2002) and Partridge (1997) conducted empirical researches with U.S. states panel data, Simoes et. al. (2013) used Portuguese regional panel data, and Kurita and Kurosaki (2011) used Thai and the Philippine regional panel data. The research in Panizza (2002) found evidence in support of a negative relationship between inequality and growth, using a data of the 48 states of the continental US for the 1940-1980 period.

In the research using panel data of U.S. states, Partridge (1997) found out that inequality measured with the Gini index has positive and significant effect on growth, and that inequality measured with the income share of the third quintile has negative and significant effect on growth. Partridge (1997) and Panizza (2002) both used the same two measures of income distribution, the Gini indices and the income share of the third quintile. This research used four measures of inequality including these same two measures on the Japanese prefectural panel data and found that inequality had negative effects on growth. Partridge (1997) explains his result the median voter theory, and this theory can also be applied to some of the results from Japanese data.

In addition, Simoes et. al. (2013) and Voitchovsky (2005) analyzed the effects of different distribution measures on growth with cross-country panel data. In addition to the general Gini indices, they used income percentile data of the top income group and the bottom income group to analyze their effects on income, and found different effects from different measures of inequality. Thus, in this research, I analyzed the effects of the Gini indices and the income share of the third quintile at first, then, I also investigated the effects of the income share of the top 10% income group and the bottom 10% income group.

Using a regional panel data within one country has an advantage that the county's stage of growth, other factors such as whether a country is open to capital flows from abroad, and the measurement method of inequality are the same in the data. Therefore, in this paper, prefectural panel data from Japan is used, following the recent empirical researches. Since such research using Japanese panel data has been conducted for the first time, it is important to find out what kind of effects this data shows.

This paper is organized as follows. Section 2 illustrates data set; Section 3 presents the results of estimation; Section 4 concludes.

2. Data

In this paper, Japanese prefectural panel date is used. The summary statistics is shown in table 1, and the correlation matrix is shown in table 2.

Data is a panel for 47 prefectures for the 1980 (1979 for the distribution variables) – 2010 (2009), every 5 years for 6 periods. growth5 is the five-year average annual growth rate from the base year. LogIncome is the natural log of the average per capita income in prefectures. These data are obtained or calculated from "the Annual Report on Prefectural Accounts" released by the Cabinet Office.

Gini is the Gini index about the yearly income and Q3 is the income share of the third quintile in 47 prefectures. 90/50 is the ratio of the income

Table1 Summary Statistics

	No.of obs.	Average	S.E.	Minimum	Maximum
growth5	282	0.0117	0.0245	-0.0375	0.0654
growth10	141	0.0145	0.0253	-0.0200	0.0627
LogIncome	329	3.3730	0.1110	3.0790	3.6646
Gini	282	0.2523	0.0850	0.0590	0.3800
Q3	282	0.1769	0.0045	0.1565	0.1892
90/50	282	2.7151	0.2499	2.1666	4.0816
10/50	282	0.4024	0.0344	0.3067	0.5091
HighSchool	282	41.1663	5.8431	25.0151	56.8238
College	282	20.1745	8.2518	7.3391	47.6881
Agriculture	282	10.2585	6.0017	0.4000	26.6000
Urban	282	48.5993	18.5704	23.4000	98.0000
Old	282	16.7283	4.6685	6.1636	27.1352
Manufacturing	282	20.8058	6.5005	4.9178	34.6487
FinanInsRealEst	282	3.3291	0.9038	2.0771	7.0241
Government	282	3.7017	0.8064	2.2581	6.7096

Table2. Correlation Matrix

	LogIncome	growth5	growth10	Gini	Q3	10/50	90/50	HighSchool	College	Agriculture	Urban	Old	Manufacturing	FinanInsRealEst	Government
LogIncome	1														
growth5	-0.759	1.000													
growth10	-0.879	0.948	1.000												
Gini	0.707	-0.601	-0.944	1.000											
Q3	-0.254	0.332	0.258	-0.378	1.000										
10/50	-0.237	0.474	0.555	-0.525	0.230	1.000									
90/50	0.308	-0.422	-0.391	0.470	-0.940	-0.427	1.000								
HighSchool	0.379	-0.384	-0.742	0.337	0.089	-0.157	-0.039	1.000							
College	0.780	-0.738	-0.728	0.512	-0.401	-0.312	0.426	0.224	1.000						
Agriculture	-0.741	0.476	0.510	-0.366	0.326	0.001	-0.300	-0.157	-0.760	1.000					
Urban	0.382	-0.148	-0.153	0.103	-0.346	0.074	0.311	-0.094	0.537	-0.697	1.000				
Old	0.251	-0.382	-0.732	0.636	-0.142	-0.475	0.201	0.172	0.234	0.053	-0.348	1.000			
Manufacturing	0.197	0.217	0.116	-0.174	0.303	0.472	-0.353	0.064	-0.098	-0.310	-0.018	-0.288	1.000		
FinanInsRealEst	0.424	-0.138	-0.224	0.159	-0.286	0.093	0.246	-0.044	0.554	-0.645	0.835	-0.350	-0.015	1.000	
Government	-0.403	0.030	0.060	0.017	-0.119	-0.250	0.124	0.022	-0.178	0.373	-0.157	0.119	-0.785	-0.138	1.000

share of the top income decile and the 5th income decile, and 10/50 is the ratio of the income share of the bottom income decile and the 5tn income decile in prefectures.

The Gini indices data is obtained from "the National Survey of Family Income and Expenditure." The data on the income share of the third quintile, 90/50 and 10/50 are calculated from the yearly household pretax income share by deciles in "the National Survey of Family Income and Expenditure.[1]"

Table 2 shows that the correlation between the Gini index and Q3 is -0.378. The Gini index is the established measure of income distribution, and the negative correlation with the Gini index shows that Q3 is the measure of income equality.

Also, the figure 2 shows the change of the income share of the third quintile (Q3) at the horizontal axis, and the change of the income share of the first and second quintiles (Q1 + Q2) and that of the richer fourth and fifth quintiles (Q4 + Q5) at the vertical axis. This figure shows that when the income share of the middle class increases, income share of the poorer two quintiles tend to increase and the income share of the richer two quintiles tend to decrease. Therefore, we can interpret that the overall income inequality tends to decrease when Q3 increases.

In Figure 3, the correlation between the change of Q3 and the change of the ratio of income share of the top decile and the 5^{th} decile (90/50), and the correlation between the change of Q3 and the change of the ratio of income share of the bottom decile and the 5^{th} decile (10/50) are shown. Table 2 shows us that the correlation between Q3 and 90/50 is -0.940 and the correlation between Q3 and 10/50 is 0.230. Therefore, the income share of the middle quintile has strong negative correlation with the income share of the top decile, and has week positive correlation with the income share of the bottom decile. Figure 3 also shows that the Q3 and the 90/50 has negative correlation, and the Q3 and the 10/50 has week positive correlation. This also indicates that the Q3 is the measure of equality.

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[1] The data of the Gini indices and the yearly household pretax income share by deciles in "the National Survey of Family Income and Expenditure" are data about the households who have two persons or more. The data on the number of household members in each prefecture is not available, so the household income is used in this research instead of per-capita income adjusted by the equivalence scale.

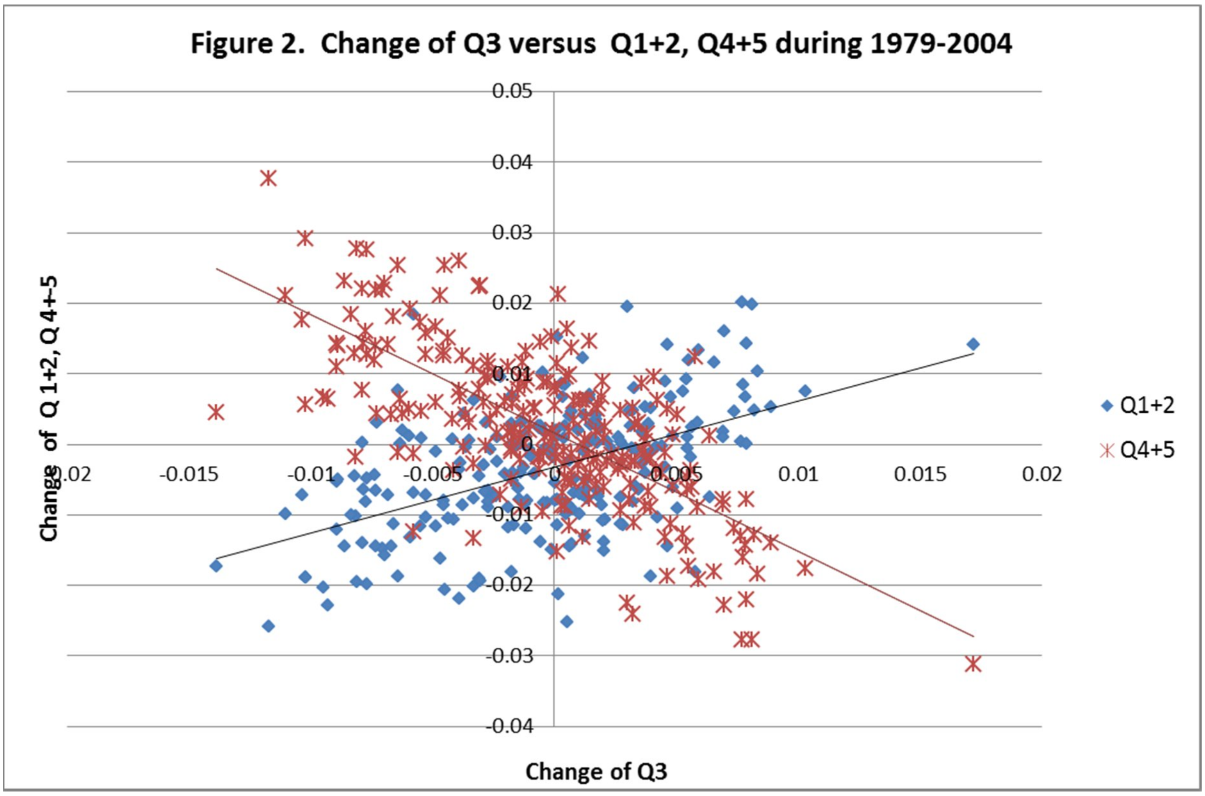
Figure 2. Change of Q3 versus Q1+2, Q4+5 during 1979-2004
0.05
0.04
0.03
0.02
0.01
0
-0.01
-0.02
-0.03
-0.04
-0.02
-0.015
-0.01
-0.005
0
0.005
0.01
0.015
0.02
Change of Q 1+2, Q 4+5
Change of Q3
Q1+2
Q4+5

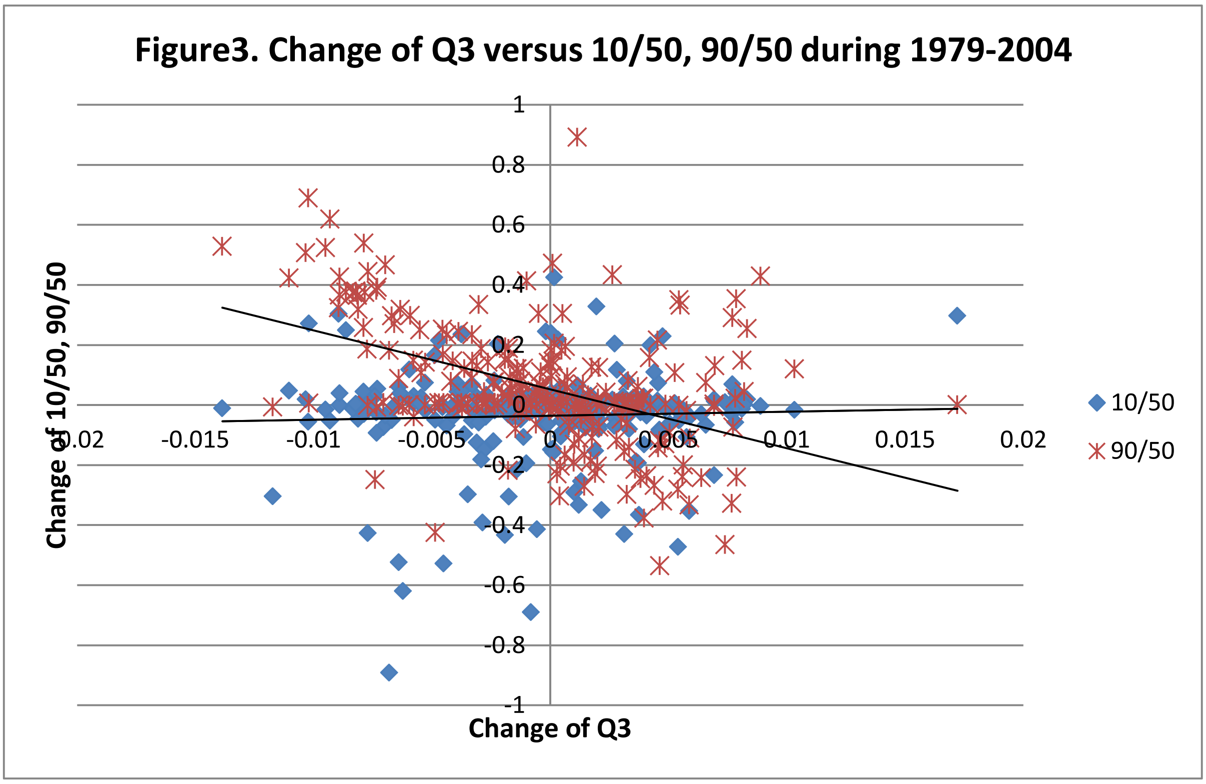
Figure3. Change of Q3 versus 10/50, 90/50 during 1979-2004
1
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
-1
-0.02
-0.015
-0.01
-0.005
0
0.005
0.01
0.015
0.02
Change of 10/50, 90/50
Change of Q3
10/50
90/50

As for the other variables, following Panizza (2002), Partridge (1997) and Perotti (1996), the first one is the average skills of the labor force (HighSchool is the percentage of the population over 15 years old that have graduated from high school, but not a college, and College is the percentage that graduated from two- or four-year college or graduate school) and they are from "the employment status survey." The next variables are the degree of urbanization (Urban measures the fraction of the population that lives in urban areas), age structure (Old measures the percentage of the population above 65 years of age), and industrial structure (Agriculture, Manufacturing, FinanInsRealEst, Government measure the percentage of the population employed in agriculture; construction; manufacturing; finance, insurance, and real estate; and government). Agriculture and Urban are the data from the "Statistical Indicator of Social Life –Prefectural Indicator－" by the Statistics Bureau, Ministry of Internal Affairs and Communications. Old, Construction, Manufacturing, FinanInsRealEst, Government are from "the Population Census."

3. Estimations

In this section, the estimation results are shown. The estimated model is the following:

$$Growth_{(t,t+5),i} = \beta y_{t,i} + \gamma DISTRI_{t-1,i} + \theta X_{t,i} + \alpha_i + \varepsilon_{t,i} \qquad (1)$$

In this equation, $Growth_{(t,t+5)}$ is the average annual growth rate of prefectural income from year t to t+5, y_i is prefecture i's natural log of income per capita, $DISTRI_{t-1,i}$ is a variable capturing income distribution (measured using the Gini index, the income share of the third quintile, 90/50, and 10/50) in year t-1 and X_i is the prefecture i's matrix of controls.

As the Kuznets curve argues, the growth or income level also affects income distribution, so there is an inverse causality from growth to income inequality. However, in this research, only the effect of inequality on growth is estimated as the first step. In order to clarify this causality, the variables on income distribution are used with one-year lag.

The matrix X_i includes stock of human capital (HighSchool and College), the degree of urbanization (Urban), age structure (Old) and the initial industrial mix of the prefecture (Agriculture, Manufacturing

FinanInsRealEst, Government). α_i denotes the prefecture i's unobservable prefecture-specific effect, and $\varepsilon_{t,i}$ is the remainder stochastic disturbance term.

The independent variables of equation (1) contain the lagged dependent variable (prefectural income) and this dynamic panel data structure may make the fixed effects estimators biased[2] (Panizza 2002; Caselli *et al.* 1996; Judson and Owen 1999). Also, we have data of 6 periods for 5 years each, and this small number of samples makes the system GMM estimation developed by Arellano and Bover (1995) and Blundell and Bond (1998) more desirable than the first-difference GMM developed by Arellano and Bond(1991). Therefore, in this research, the system GMM estimation is conducted as in the many recent literatures (Voitchovsky 2005, Kurita and Kurosaki 2011, Castello-Climent, A., 2010 etc.)

The system GMM estimation results with Q3 and the Gini indices are shown in table3. In table 3, the estimation results without the control variables are shown in the first two columns, and the results with the control variables are in the next two columns, and the results with the control variables and the period dummies are shown in the last two columns. In all estimation results, the changes of Q3 have positive effects on changes of growth when they are statistically significant, and changes in the Gini indices have negative effects on changes in growth when they are statistically significant.

Therefore, both of the income of the third quintile and the Gini indices indicate that income inequality decreases the economic growth. The difference between the two measures is that the Gini indices measure the overall income distribution, although the income share of the third quintile measures the income or well-being of the middle class of the economy. In addition, we should note that in these estimations the population aging is controlled by the variable Old (the share of the residents who are older than 65 years), and Old does not have statistically significant effects on growth[3].

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[2] The OLS, the random effects and the fixed effects estimations are also made, and the F-tests and Hausman tests results show that the fixed effects estimation is the desirable among these three estimation methods. The fixed effects estimation results are biased and are not reported in this paper.

[3] Ohtake and Sano (2009) used prefectural panel data and median voter theory and found out that population aging has negative effects on public spending on education. Therefore, the higher share of old people can affect education (College) negatively and results in lower economic growth.

As for Q3, Partridge (1997) used the U.S. state panel data and obtained the same positive effects. Partridge explained this result with a positive relationship between the median voter's relative well-being and economic growth as suggested by the Persson and Tabellini (1994) and Alesina and Rodrik (1994).

The Q3 results from Japanese data can also be explained with the median voter theory. According to the median voter theory, the decision over the tax rate is reached under simple majority rule in voting. Then, the tax rate or the policy chosen will be the one preferred by the person with the median level of pretax income, who is often referred to as the median voter. (Alesina and Rodrik 1994, Weil 2013)

Under this median voter theory, if the income share of the median voter who is included in the third quintile increases, s/he demands less redistribution. Then, the tax rate will be lower and there will be less inefficiency caused by tax and redistribution, which leads to higher economic growth rate.

Although Japanese prefectural governments are more centralized than U.S. state governments, Doi (1999) empirically showed that the median voter theory also applies to Japanese prefectural governments. In Japan, prefecture revenues are almost entirely controlled by the central government, with the rates and sources of Local Taxes being basically determined by national laws such that prefectural governments have limited discretion over them. However, governors petition the central government as the agents of the median voters and that the central government accordingly distributes inter-regional grants to each prefectural government in a manner reflecting prefectural election results, i.e., the jurisdictional preference of the median voter. The probability of reelection for an incumbent governor increased as the difference between the actual level of expenditure and the estimated level desired by the median voter decreased ; a finding which supports the interpretation of the median voter hypothesis in Japanese prefectures.

As for the Gini indices, the negative effects on growth can be caused by the lower investment in human capital such as education, more redistribution and more inefficiency, and political instability in Japan. About the political instability, Japan had five short-lived cabinets, each of which lasted for less than one year since 2006. These often changed cabinets make the government policies unstable and make it harder for private agents to invest aggressively.

About other independent variables, if the initial income level is higher, growth rate is lower, which means that prefectural per capita incomes tend to converge. The human capital measured by the shares of college graduates among residents has positive effects on growth, which is the expected positive effect of human capital. In addition, larger share of

Table3 System GMM Estimations

	No controls			Controls			Controls and Period Dummies		
LogIncome	-0.314	-0.258	-0.331	-0.596	-0.598	-0.599	-0.574	-0.582	-0.575
	(.0440)***	(.0240)***	(.0442)***	(.0632)***	(.0635)***	(.0651)***	(.0676)***	(.0678)***	(.0684)***
Q3		0.386	-0.382		0.413	0.277		0.387	0.274
		(.2193)*	(.3508)		(.1900)**	(.3269)		(.1964)**	(.3316)
Gini	-0.177		-0.270	-0.125		-0.055	-0.114		-0.048
	(.0692)**		(.1143)**	(.0610)**		(.1074)	(.0641)*		(.1102)
HighSchool				-0.001	-0.001	-0.001	-0.001	-0.001	-0.001
				(.0005)	(.0005)	(.0005)	(.0007)	(.0007)	(.0007)
College				0.002	0.002	0.002	0.002	0.002	0.002
				(.0009)**	(.0008)**	(.0009)**	(.0011)*	(.0011)*	(.0011)*
Urban				-0.001	-0.001	-0.001	-0.001	-0.001	-0.001
				(.0009)	(.0008)	(.0009)	(.0009)	(.0009)	(.0009)
Old				0.000	0.000	0.000	0.001	0.001	0.001
				(.0014)	(.0014)	(.0015)	(.0020)	(.0020)	(.0020)
Agriculture				0.002	0.001	0.001	0.002	0.001	0.002
				(.0020)	(.0020)	(.0021)	(.0022)	(.0022)	(.0022)
Manufacturing				0.003	0.003	0.003	0.002	0.002	0.002
				(.0016)*	(.0016)	(.0016)	(.0017)	(.0016)	(.0018)
FinanInsRealEst				0.021	0.022	0.021	0.021	0.022	0.021
				(.0064)***	(.0060)***	(.0066)***	(.0067)***	(.0066)***	(.0068)**
Government				0.009	0.010	0.009	0.010	0.011	0.010
				(.0093)	(.0093)	(.0095)	(.0098)	(.0098)	(.0100)
Constant	1.164	0.739	1.421	1.881	1.743	1.809	1.833	1.755	1.735
	(.1528)***	(.1105)***	(.2023)***	(.2380)***	(.2353)***	(.2711)***	(.2480)***	(.2402)***	(.2874)***
N. obs.	188	188	188	188	188	188	188	188	188

Notes: standard errors in parentheses

* Denotes a parameter which is significant at 10%;、** at 5%, and *** at 1%.

employment in manufacturing, finance, insurance and real estate raised the growth rates. This may mean that these industries had higher growth rates of income or productivity.

Next, I used the different income distribution measures to estimate their effects on growth. Specifically, I used the ratio of the income share of the top decile and the 5th decile (90/10) and the ratio of the income share of the bottom decile and the 5th decile (10/50) to analyze how the distribution change in the top income and the bottom income affect the growth. This is because the existing researches such as Halter, et. al. (2014), Castello-Climent (2010) and Voitchovsky (2005) have shown that the different parts of income distribution such as the income share of the top and bottom can have different effects on growth from the general distribution shown by the Gini and the income share of the middle class shown by Q3.

The system GMM estimation results are in table 4 to 6. Table 4 shows the estimation results without the control variables, table 5 shows the results with the control variables, and the table 6 shows the results with the control variables and the period dummies. In all tables, we find that the income share of the bottom decile does not have statistically significant effects, although the income share of the top decile mainly has negative

Table4 System GMM Estimations: No Controls

	10/50	90/50	Gini and 10/50	Gini and 90/50	10/50 and 90/50	Gini, 10/50 and 90/50
LogIncome	-0.287	-0.262	-0.335	-0.346	-0.287	-0.348
	(.025)***	(.0238)***	(.0457)***	(.0446)***	(.0250)***	(.0473)***
10/50	0.031		0.016		0.027	-0.036
	(.0344)		(.0352)		(.0342)	(.0447)
90/50		-0.007		0.014	-0.006	0.020
		(.0043)		(.0090)	(.0043)	(.0117)*
Gini			-0.143	-0.354		-0.461
			(.0718)**	(.1493)**		(.1990)**
Constant	0.912	0.956	1.142	1.329	0.971	1.323
	(.0841)***	(.0893)***	(.1534)***	(.1570)***	(.0904)***	(.1683)***
N. obs.	141	141	141	141	141	141

Notes: Robust standard errors in parentheses

* Denotes a parameter which is significant at 10%;、 ** at 5%, and *** at 1%.

Table5. System GMM Estimations: With Controls

	Gini	10/50	90/50	Gini and 10/50	Gini and 90/50	10/50 and 90/50	Gini, 10/50 and 90/50
LogIncome	-0.596	-0.586	-0.605	-0.596	-0.606	-0.605	-0.607
	(.0632)***	(.0638)***	(.0632)***	(.0641)***	(.0653)***	(.0644)***	(.0670)***
10/50		0.003		-0.013		0.005	0.020
		(.0321)		(.0330)		(.0319)	(.0404)
90/50			-0.009		-0.012	-0.009	-0.016
			(.0038)**		(.0090)	(.0039)**	(.01116)
Gini	-0.125			-0.129	0.045		0.114
	(.0610)**			(.0641)**	(.1454)		(.1834)
HighSchool	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001
	(.0005)	(.0005)	(.0005)	(.0005)	(.00058)	(.00058)	(.00060)
College	0.002	0.002	0.002	0.002	0.002	0.002	0.002
	(.0009)**	(.0009)**	(.0008)**	(.0009)**	(.0009)**	(.0009)**	(.00098)
Urban	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001
	(.0009)	(.00092)	(.0008)	(.0009)	(.00092)	(.00091)	(.00094)
Old	0.000	0.000	0.000	0.000	0.000	0.001	0.000
	(.0014)	(.0014)	(.0014)	(.0015)	(.00157)	(.00147)	(.00166)
Agriculture	0.002	0.002	0.002	0.002	0.002	0.002	0.002
	(.0020)	(.00212)	(.0020)	(.0021)	(.0021)	(.0021)	(.00212)
Manufacturing	0.003	0.003	0.003	0.003	0.003	0.003	0.003
	(.0016)*	(.0016)*	(.0015)*	(.0016)*	(.0016)*	(.0016)*	(.0016)*
FinanInsRealEst	0.021	0.024	0.022	0.021	0.022	0.023	0.024
	(.0064)***	(.0062)***	(.0061)***	(.0065)***	(.0066)***	(.00623)***	(.0066)***
Government	0.009	0.007	0.011	0.010	0.011	0.010	0.010
	(.0093)	(.0095)	(.0093)	(.0095)	(.0095)	(0.0095)	(.0096)
Constant	1.881	1.798	1.881	1.893	1.886	1.877	1.872
	(.2380)***	(.2389)***	(.2355)***	(.2442)***	(.2423)***	(.2409)***	(.2459)***
N. obs.	188	188	188	188	188	188	188

Notes: standard errors in parentheses

* Denotes a parameter which is significant at 10%;、 ** at 5%, and *** at 1%.

Table6. System GMM Estimations: With Controls and Period Dummies

	Gini	10/50	90/50	Gini and 10/50	Gini and 90/50	10/50 and 90/50	Gini, 10/50 and 90/50
LogIncome	-0.574	-0.569	-0.592	-0.570	-0.580	-0.591	-0.573
	(.0676)***	(.0671)***	(.0679)***	(.0689)***	(.0679)***	(.0694)***	(.0696)***
10/50		0.002		-0.013		0.004	0.027
		(.0329)		(.0339)		(.0330)	(.0411)
90/50			-0.009		-0.013	-0.009	-0.019
			(.0039)**		(.0092)	(.0040)**	(.0114)*
Gini	-0.114			-0.117	0.072		0.176
	(.0641)*			(.0670)*	(.1493)		(.1890)
HighSchool	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001
	(.0007)	(.0007)	(.0007)	(.0007)	(.0007)	(.0007)	(.0007)
College	0.002	0.002	0.002	0.002	0.002	0.002	0.002
	(.0011)*	(.0011)	(.0011)*	(.0011)*	(.0011)*	(.0011)*	(.0012)*
Urban	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001
	(.0009)	(.0009)	(.0009)	(.0009)	(.0009)	(.0009)	(.00096)
Old	0.001	0.001	0.001	0.001	0.001	0.001	0.001
	(.0020)	(.0020)	(.0020)	(.0020)	(.0020)	(.0020)	(.0021)
Agriculture	0.002	0.001	0.001	0.002	0.002	0.001	0.002
	(.0022)	(.0022)	(.0022)	(.0022)	(.0022)	(.0022)	(.0022)
Manufacturing	0.002	0.003	0.003	0.002	0.002	0.003	0.002
	(.0017)	(.0017)	(.0016)	(.0018)	(.0017)	(.0017)	(.0018)
FinanInsRealEst	0.021	0.023	0.022	0.022	0.022	0.023	0.023
	(.0067)***	(.0067)***	(.0066)***	(.0068)***	(.0068)***	(.0066)***	(.0068)***
Government	0.010	0.008	0.012	0.011	0.010	0.012	0.011
	(.00983)	(.0101)	(.0098)	(.0102)	(.0100)	(.0102)	(.0102)
Constant	1.833	1.783	1.867	1.834	1.836	1.860	1.780
	(.2480)***	(.2443)***	(.2456)***	(.2546)***	(.2469)***	(.2505)***	(.2505)***
N. obs.	188	188	188	188	188	188	188

Notes: standard errors in parentheses

* Denotes a parameter which is significant at 10%;、 ** at 5%, and *** at 1%.

effects on growth when they are statistically significant. The Gini indices have negative effects on growth when they are significant, as in the previous estimations. Therefore, in these estimations, we find that the inequality at the top income and the overall income inhibits economic growth. This result has the opposite sign from the existing literature which uses the cross-country panel data (Castello-Climent 2010, Voitchovsky 2005).

One of the explanations of this negative effect could be that under low growth rate and low rate of wage increase, increase in the income share of top 10% makes people feel more inequality than the actual level, which may lead to demand for more redistribution. The second possibility is that richest 10% people have more political power than others and they may be less willing to pay for the government expenditure on public educations, because they tend to use more private schools. The third possibility is that higher income share of top 10% people may make these rich individuals or firms to move their residents to foreign tax haven such as Singapore or Hong Kong, which decreases the efficiency of the economy and the tax revenue of the government.

Finally, the results of the first-difference GMM are shown in table 7 to 9 in order to see the sensitivity to changes in the estimation methods and instrument set. In these two tables, the estimated coefficients on the four distribution variables such as the Gini indices, Q3, 90/50, 10/50 have the same sign as the results in the system GMM estimation. Although the coefficients estimates on some control variables are different, the main results about the effects of inequality on growth are unchanged, and it suggests the estimate results in this research are robust.

Although the estimation results in this research show that income inequality decreased economic growth in Japan, how income inequality affected growth need to be investigated further. For example, the effects of inequality through public spending on education or college enrolment rates are planned to be estimated as the next step.

4. Conclusion

In this paper, the prefectural panel data of Japan from 1979 to 2010 is used to investigate how income inequality affects economic growth. In the system GMM estimations, income inequality affects five-year growth negatively and statistically significantly, if inequality is measured with the

Gini indices and the income share of the third quintile.

The estimation results with Q3 can be explained with the median voter theory, because if the income share of the third quintile increases, the income of the median voter also increases and less redistribution will be chosen, which decrease inefficiency and enhances growth. The negative effects of the Gini indices can be explained with less investment in human capital, more redistribution and more inefficiency, and political instability. As for the estimations with the income share of the top decile, we find that inequality decreases growth, and the income share of the bottom decile does not affect growth rate. The effect of inequality through education is planned to be estimated in future research,

Table7. Sensitivity analysis: First-difference GMM Estimations

	No controls			Controls			Controls and Period dummies		
LogIncome	-0.343	-0.421	-0.440	-0.515	-0.552	-0.584	-0.740	-0.739	-0.741
	(.0085)***	(.0191)***	(.0210)***	(.038)***	(.041)***	(.048)***	(.050)***	(.047)***	(.048)***
Q3	0.497		0.556	0.208		0.396	0.297		0.158
	(.2145)**		(.2621)**	(.151)		(.2284)*	(.1592)*		(.2227)
Gini		-0.154	-0.031		-0.013	0.067		-0.094	-0.057
		(.0562)***	(.0759)		(.0388)	(.0606)		(.0471)**	(.06631)
HighSchool				0.000	0.000	-0.001	-0.0013	-0.0011	-0.0011
				(.0003)	(.0003)	(.0002)*	(.00061)**	(.00061)*	(.00059)*
College				0.000	0.001	0.001	-0.001	-0.001	-0.001
				(.0004)	(.0004)	(.0004)	(.0006)	(.0006)	(.0006)
Urban				0.000	0.000	0.000	0.000	0.000	0.000
				(.0006)	(.0005)	(.0005)	(.0005)	(0.0005)	(.0005)
Old				-0.005	-0.004	-0.003	-0.003	-0.003	-0.003
				(.001)***	(.001)***	(.001)**	(.001)**	(.001)**	(.001)**
Agriculture				-0.001	0.000	-0.001	0.001	0.001	0.001
				(.0013)	(.0014)	(.0013)	(.0011)	(.0011)	(.0011)
Manufacturing				0.000	0.001	0.001	0.002	0.002	0.002
				(.0010)	(.0009)	(.0009)	(.0009)**	(.0009)**	(.0009)*
FinanInsRealEst				0.002	0.002	0.002	0.007	0.006	0.006
				(.0060)	(.0059)	(.0058)	(.0053)	(.0051)	(.0054)
Government				0.002	0.004	0.006	0.007	0.007	0.007
				(.0073)	(.0068)	(.0067)	(.0058)	(.0059)	(.005)
Constant				1.730	1.856	1.776	2.476	2.560	2.550
				(.173)***	(.165)***	(.178)***	(.227)***	(.221)***	(.241)***
p-value[1]			0.006***			0.214			
N. obs.	188	188	188	188	188	188	188	188	188

Notes: Robust standard errors in parentheses

* Denotes a parameter which is significant at 10%;、 ** at 5%, and *** at 1%.

[1] Wald joint test on the inequality variable coefficients in the regression

Table8. Sensitivity analysis: First-difference GMM Estimations with Controls

	Gini	10/50	90/50	Gini and 90/50	Gini and 10/50	10/50 and 90/50	Gini, 10/50 and 90/50
LogIncome	-0.618	-0.601	-0.618	-0.629	-0.616	-0.616	-0.628
	(.0631)***	(.0633)***	(.062)***	(.0654)***	(.064)***	(.064)***	(.066)***
10/50		-0.008			-0.021	-0.003	0.004
		(.0311)			(.0319)	(.0311)	(.0401)
90/50			-0.009	-0.010		-0.009	-0.011
			(.0039)**	(.0088)		(.004)**	(.0112)
Gini	-0.130			0.004	-0.135		0.032
	(.0637)**			(.1440)	(.066)**		(.18627)
HighSchool	0.000	-0.001	0.000	-0.001	-0.001	-0.001	-0.001
	(.0006)	(.0007)	(.0006)	(.0006)	(.0007)	(.0007)	(.0007)
College	0.001	0.001	0.002	0.001	0.001	0.002	0.001
	(.0009)	(.0009)	(.0009)*	(.0009)	(.0009)	(.0009)*	(.0009)
Urban	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001
	(.0009)	(.0009)	(.0008)	(.0009)	(.0009)	(.0009)	(.0009)
Old	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	(.0014)	(.0014)	(.0014)	(.0015)	(.0015)	(.0014)	(.0016)
Agriculture	0.003	0.002	0.003	0.003	0.003	0.003	0.003
	(.0021)	(.0021)	(.0020)	(.0021)	(.0021)	(.0021)	(.0021)
Manufacturing	0.003	0.003	0.003	0.003	0.003	0.003	0.003
	(.0015)*	(.0016)*	(.0015)*	(.0015)	(.0016)	(.0016)*	(.0016)*
FinanInsRealEst	0.011	0.011	0.013	0.013	0.012	0.013	0.013
	(.0082)	(.0082)	(.0082)	(.0083)	(.0083)	(.0082)	(.0083)
Government	0.015	0.015	0.016	0.015	0.016	0.017	0.016
	(.0091)	(.0094)	(.0091)*	(.0092)*	(.0093)*	(.0093)*	(.0094)*
Constant	2.015	1.994	1.977	2.033	2.025	1.968	2.031
	(.254)***	(.2593)***	(.2503)***	(.2580)***	(.260)***	(.256)***	(.2619)***
p-value[1]				0.054*	0.128	0.082*	0.144
N. obs.	141	141	141	141	141	141	141

Notes: Robust standard errors in parentheses

* Denotes a parameter which is significant at 10%;、 ** at 5%, and *** at 1%.

[1] Wald joint test on the inequality variable coefficients in the regression

Table9. First-difference GMM Estimations With Controls and Period Dummies

	Gini	10/50	90/50	Gini and 90/50	Gini and 10/50	10/50 and 90/50	Gini, 10/50 and 90/50
LogIncome	-0.739	-0.732	-0.738	-0.740	-0.741	-0.737	-0.742
	(.0479)***	(.0496)***	(.0497)***	(.0484)***	(.0491)***	(.0499)***	(.0493)***
10/50		0.002			-0.010	0.003	-0.007
		(.0262)			(.0260)	(.0254)	(.0353)
90/50			-0.005	-0.001		-0.005	0.000
			(.0029)*	(.0061)		(.0029)*	(.0082)
Gini	-0.095			-0.082	-0.100		-0.096
	(.0471)**			(.0993)	(.0496)**		(.1406)
HighSchool	-0.0011	-0.0013	-0.0012	-0.0011	-0.0011	-0.0012	-0.0011
	(.00061)*	(.00061)**	(.00062)**	(.00061)*	(.0006)*	(.0006)**	(.00059)*
College	-0.001	-0.001	-0.001	-0.001	0.000	-0.001	-0.001
	(.0006)	(.0006)	(.0006)	(.00065)	(.0005)	(.0006)	(.00065)
Urban	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	(.0005)	(.0005)	(.00058)	(.0005)	(.0005)	(.0005)	(.0005)
Old	-0.003	-0.004	-0.003	-0.004	-0.003	-0.003	-0.003
	(.0014)**	(.0015)**	(.0015)**	(.0015)**	(.0015)**	(.0015)**	(.0015)**
Agriculture	0.001	0.001	0.001	0.001	0.001	0.001	0.001
	(.0011)	(.0012)	(.0011)	(.0011)	(.0011)	(.0011)	(.00115)
Manufacturing	0.002	0.002	0.002	0.002	0.002	0.002	0.002
	(.0009)**	(.0009)**	(.0009)**	(.0010)*	(.00096)**	(.00093)**	(.00099)*
FinanInsRealEst	0.006	0.006	0.007	0.006	0.007	0.007	0.006
	(.0051)	(.0054)	(.0053)	(.0054)	(.0051)	(.0053)	(.00529)
Government	0.007	0.005	0.007	0.007	0.007	0.007	0.007
	(.0059)	(.0054)	(.0059)	(.0059)	(.0058)	(.0059)	(.0058)
Constant	2.560	2.534	2.541	2.571	2.573	2.535	2.587
	(.2213)***	(.2214)***	(.2235)***	(.2217)***	(.2229)***	(.2245)***	(.2241)***
N. obs.	188	188	188	188	188	188	188

Notes: Robust standard errors in parentheses

* Denotes a parameter which is significant at 10%;、 ** at 5%, and *** at 1%.

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