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. Theoretically, the effects of income distribution on growth have both signs and the overall effect is an empirical problem. Therefore, this paper uses Japanese prefectural panel data from 1979 to 2010 in order to empirically analyze how income distribution has affected economic growth in Japan.

Four measures of the income distribution are used in the system GMM estimations and the Arellano-Bond GMM estimations. The Gini indices, income share of the third quintile and the ratio of the income share of the top decile and the 5th decile show that income equality has positive effects on growth. The ratio of the income shares of the bottom decile and the 5th decile does not have statistically significant effects.

Therefore, the estimation results show that the income equality at different levels of income had different effect on economic growth in recent Japan. This result is consistent with existing researches and considered to be robust.

The channels through which the income equality affected economic growth are planned to be investigated next. For example, the effects through investment in human capital or physical capital are to be estimated in the future research.

JEL Classification Number: D31, O47, C2
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1. Introduction

A large number of theoretical and empirical studies have been published regarding the relationship between income distribution and economic growth. According to Weil (2013, pp. 400-409), to Halter, Oechslin, and Zweimüller (2014, pp. 84-85), and to Kobayashi (2016), theoretical research affirms that equality in income distribution exerts positive effects on economic growth via four different channels.

Firstly, if there are imperfections in capital markets, then more equal distribution of income will increase accumulation of human capital. This is because the number of family budgets facing liquidity constraints will decrease, permitting increased investment or expenditures for education (Perotti, 1996, p. 152). Secondly, if distribution is equal, there will be less fiscal redistribution of income by the government, so equal distribution has a positive effect on growth by means of lower tax rates and greater efficiency in economic activity (Perotti, 1996, p. 151; Alesina & Rodrick, 1994, p. 465; Persson & Tabellini, 1994, p. 600). Thirdly, if income distribution is equal, there will be greater political stability, making it easier to make predictions regarding future economic policies (Perotti, 1996, p. 152). Fourthly, as wealth disparities and excess household debt decrease, there is a possibility that consumer demand will rise, causing total demand in the economy as a whole to expand, thereby boosting economic growth (Kobayashi, 2016).

However, equality in income distribution also exerts negative effects on economic growth by decreasing the savings rate and the accumulation of physical capital. That is because high-income individuals have a high savings rate, so with increased equality the overall savings rate will decline (Weil, 2013, pp. 400-409). In addition, a high degree of equality also exerts a negative effect on growth by reducing the proportion of high-income individuals — who are thought to have high risk tolerance — and thereby reducing innovation (Foellmi & Zweimüller, 2006, p. 941).

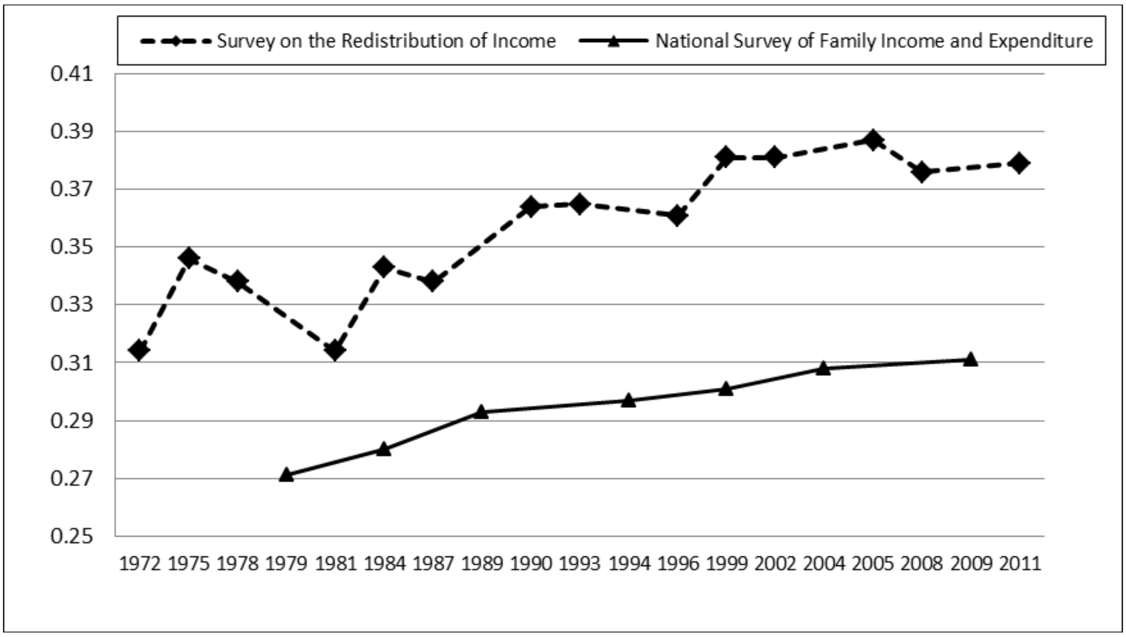
In short, income distribution has both positive and negative effects on economic growth, and which of the two sides is predominant is an empirical question. As a result, empirical research of the kind presented in this paper is important.

Figure 1-1 shows changes in the Gini coefficients in two major Japanese surveys over time. The dashed line indicates the Gini coefficient for income after redistribution as found in the *Survey on the Redistribution of Income*, while the solid line represents the Gini coefficient for pretax household income in the *National Survey of Family Income and Expenditure*. From the figure, it is clear that Gini coefficients have been rising since 1970.

There has been lively debate regarding whether this rise in the Gini coefficients actually shows that equality in income distribution has declined (Ohtake, 2005, pp. 1-106; Tachibanaki, 2006, pp. 29-34; Oshio, Tajika, & Fukawa, 2006, pp. 11-38, 141-158). According to the studies published, it has become clear that while roughly half of the rise in the Gini coefficients was due to aging of the population and an increase in one- and two-person households, there was also a rise in consumption inequality within individual generations (Ohtake, 2005, p. 61). According to the permanent income hypothesis, consumption levels depend on permanent income, so a decline in equality in consumption would seem to reflect a decline in equality in permanent incomes.

In addition, in the 1990s the Japanese income tax system was made flatter, and the maximum rate for inheritance taxes was reduced as well. In recent years, however, income disparities have turned into a social problem, and consequently the maximum income-tax rate has been raised, inheritance taxes have been increased, and there has been discussion of implementing the concept of equal pay for equal work. What sort of effect do these types of changes in income distribution have on economic growth?

Fig. 1-1. Gini coefficients over time



In the existing empirical research, the results of estimations regarding the effect of income distribution on economic growth vary depending on the data and the estimation method used. Earlier, most estimations used cross-sectional data, but in recent years there have been many studies — such as Deininger and Squire (1996) — that use cross-country panel data, as well as many that use regional-level panel data within individual countries.

Although both the majority of studies that used cross-sectional data, and those studies — such as Cingano (2014, p. 6) and Ostry, Berg, and Tsangarides (2014, p. 4) — that used cross-country panel data, have found a positive correlation between equality of distribution and economic growth, studies such as Forbes (2000, p. 869) and Li and Zou (1998, p. 318), which used Deininger and Squire's cross-country panel data, have found a negative correlation between equality and growth (Castelló-Climent, 2010, p. 294).

Weil (2013, pp. 409-410) affirms that the reason why it is difficult to come to a single conclusion regarding the effect that income equality exerts on economic growth is because the sign that the effect has in a particular country depends on other factors such as the country's level of economic development and whether the country permits capital to enter freely from abroad. In fact, the results of estimations by Barro (2000) were that equality in distribution lowers the growth rate in rich countries but raises it in poor countries.

The use of regional-level panel data from a single country has the advantages that the economic development level, the question of whether the country permits capital to enter freely from abroad, and the methods used to measure indicators of income distribution will all be the same (Dominicis, Florax, & Groot, 2008, pp. 654, 662). For that reason, this paper uses prefecture-level panel data in its estimations.

In recent years, Panizza (2002, p. 25) and Partridge (1997, p. 1019) have carried out empirical studies using US state-level panel data, while Simoes, Andrade, and Duarte (2013, p. 427) have done so using Portuguese regional-level panel data, and Kurita and Kurosaki (2011, p. 3) have done so using regional-level panel data from Thailand and the Philippines. In particular, Panizza (2002, p. 25), using panel data from 48 US states for the period from 1940 through 1980, concluded that there is a positive correlation between equality and growth, and Partridge (1997, pp. 1019, 1030), in research that also used US state-level panel data, reached the conclusion that, when measured using the Gini coefficient, equality of distribution has a statistically significant negative impact on economic growth, but that when it is measured using the income share of the third quintile, equality has a statistically significant positive impact on growth. Partridge (1997, pp. 1021-1022) and Panizza (2002, p. 27) used the same two income-distribution indicators — the Gini coefficient and the income share of the third quintile — in their estimations.

In addition, Simoes et al. (2013, p. 447) and Voitchovsky (2005, pp. 273, 279), in estimations that used regional-level panel data from Portugal and cross-country panel data, respectively, found that when income percentile data for the top income stratum and the bottom income stratum were used in tandem with the most general indicator, i.e., the Gini coefficient, then the effect of income distribution on growth depended on the income-distribution indicator used.

In this paper, therefore, I build on these previous studies by taking a total of four indicators of income distribution — the two indicators used by Partridge (1997, pp. 1021-1022) and Panizza (2002, p. 27) as well as two other indicators — and applying them to Japanese data, and I show that equality had a positive effect on economic growth. In using the four indicators, I first estimate the effect using the Gini coefficient and the income share of the third quintile, and then estimate the effect using the income distribution of the decile with the highest income and the decile with the lowest income.

One of the most recent studies, that of Piketty (2014, p. 603), analyzes long-term data extending over more than 200 years and affirms that because previously accumulated wealth grows faster than production or wages, the distribution of wealth and income becomes more unequal over time. Piketty affirms that this tendency toward inequality does not help to encourage growth either, a finding that is consistent with the conclusions of this paper.

In Section 2 of this paper, I explain the data that I used, while in Section 3 I explain the results of the estimations, and in Section 4 I summarize the entire paper and present conclusions.

2. Data

Basic statistics for the data are shown in Table 2-1, and the correlation coefficients are given in Table 2-2. The data are for the six 5-year periods between 1980 and 2010 (or 1979 and 2009, respectively, in the case of income-distribution indicators). “growth5” is the average annual growth rate for the five-year period, starting in the base year. “LogIncome” is the natural logarithm of per-capita income for prefectural residents. The data for income of prefectural residents are the sum of employee compensation received by prefectural residents, of property income (i.e., net property income received by parties other than enterprises), and of income received by enterprises (including net property income received by enterprises), and were either obtained from, or calculated on the basis of, the *Annual Report on Prefectural Accounts* published by the Cabinet Office.

“Gini” is the Gini coefficient for annual household income in the 47 prefectures, while “Q3” is the income share of the third quintile. “90/50” is the income share of the highest-income decile divided by the income share of the fifth decile, and “10/50” is the income share of the lowest-income decile divided by the income share of the fifth decile.

The Gini-coefficient data were obtained from the *National Survey of Family Income and Expenditure*. The income share of the third quintile, as well as 90/50 and 10/50, were calculated from the pretax household income by deciles that is provided in the *National Survey of Family Income and Expenditure*.[1]

Table 2-1. Basic statistics

	No. of obs.	Average	SD	Minimum	Maximum
growth5	282	0.0117	0.0245	-0.0375	0.0654
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

[1] The data on Gini coefficients and on pretax annual household income by deciles that were obtained from the *National Survey of Family Income and Expenditure* were for households of two or more persons. Although estimations should use per-capita income adjusted via an equivalence scale, in this case prefectural data on household size were not available, so in this paper I use household-income data.

Government	282	3.7017	0.8064	2.2581	6.7096

Table 2-2. Correlation coefficients

	LogIncome	growth5	Gini	Q3	10/50	90/50
LogIncome	1.000					
growth5	-0.759***	1.000				
Gini	0.707***	-0.601***	1.000			
Q3	-0.254***	0.332***	-0.378***	1.000		
10/50	-0.237***	0.474***	-0.525***	0.230***	1.000	
90/50	0.308***	-0.422***	0.470***	-0.940***	-0.427***	1.000

N.B.: *** indicates the figure is significant at the 1% level.

Fig. 2-1. Change in Q3 vs. change in Q1+2 and Q4+5 (1979-2004)

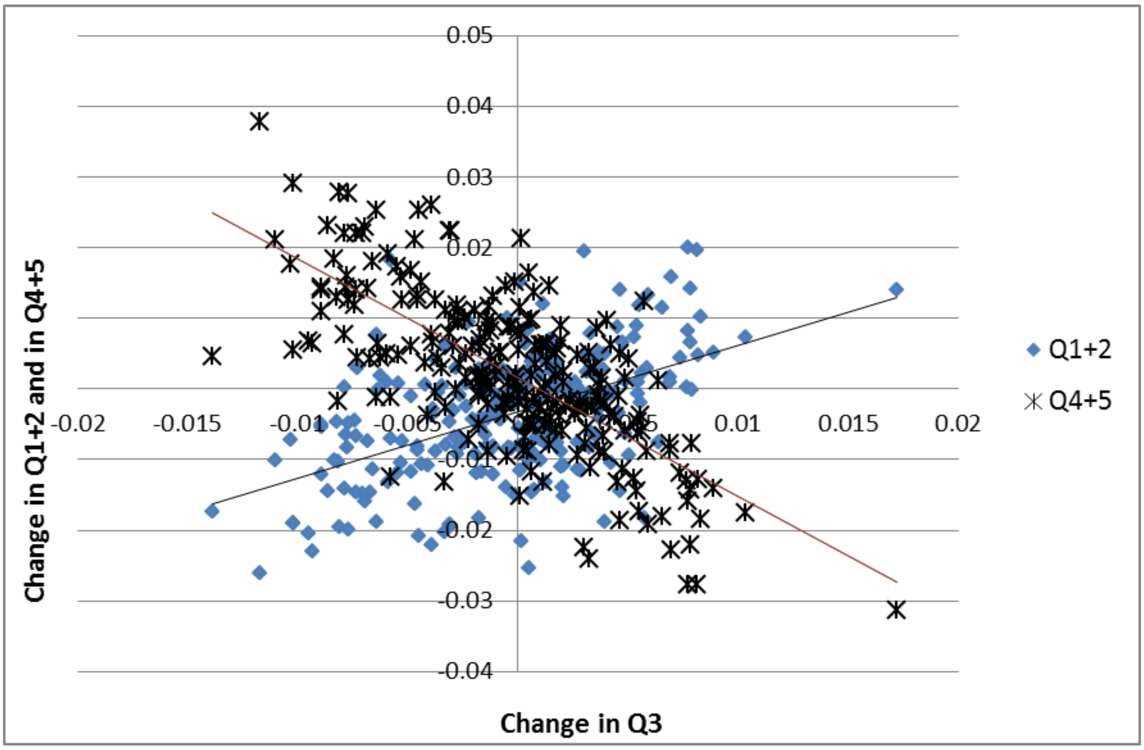
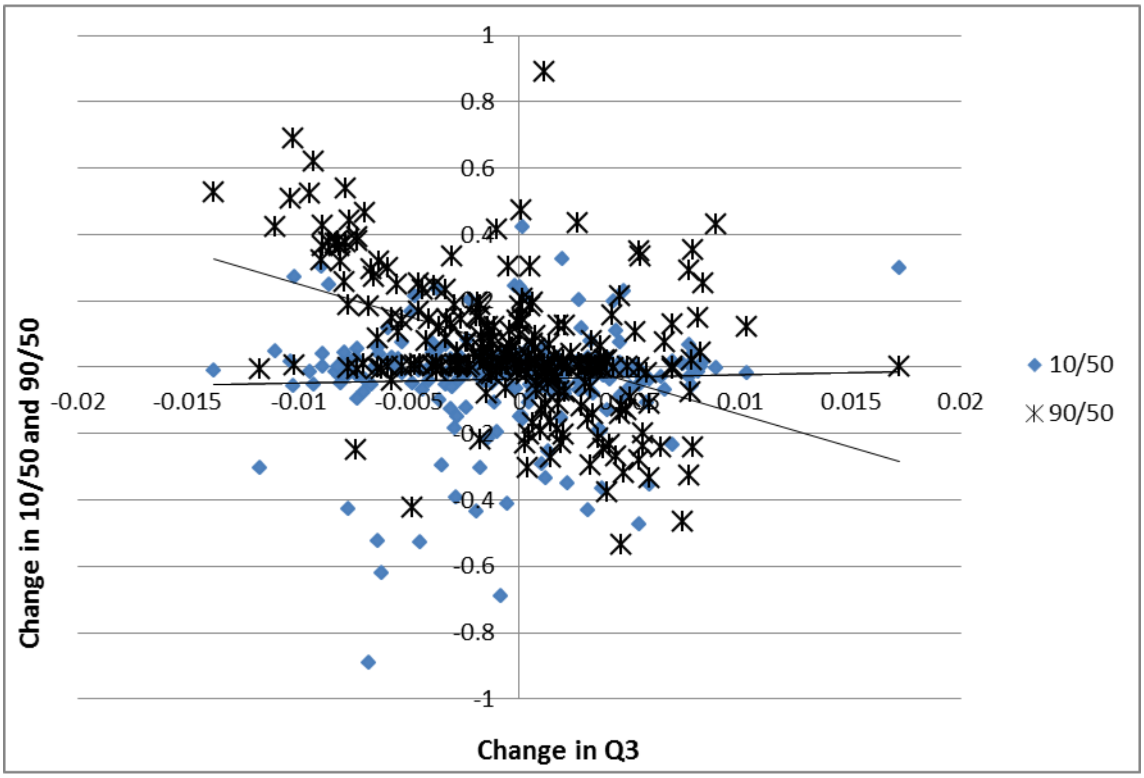


Fig. 2-2. Change in Q3 vs. change in 10/50 and 90/50 (1979-2004)



As shown in Table 2-2, the coefficient of correlation between the Gini coefficient and Q3 was -0.378. In the Gini coefficient, which is the most frequently used indicator of income distribution, the higher the coefficient, the lower the degree of equality. So, since Q3 has a negative correlation with the Gini coefficient, the fact that Q3 is high would indicate that equality increased.

In Figure 2-1, change in the income share of the third quintile (Q3) is plotted on the horizontal axis, while changes in the income shares of the lowest two quintiles (Q1 + Q2) and of the highest two quintiles (Q4 + Q5) are plotted on the vertical axis. The graph shows that when the income share of the third quintile increased, the income share of the lowest two quintiles increased but that of the highest two quintiles decreased. This means that an increase in Q3 can be interpreted as increased equalization in overall income distribution.

Figure 2-2 shows the correlation between change in Q3 and change in the ratio of the income share of the highest-income decile to the income share of the fifth decile (90/50) as well as the correlation between change in Q3 and change in the ratio of the income share of the lowest-income decile to the income share of the fifth decile (10/50). From the figure, it is clear that Q3 has a negative correlation with 90/50 but a slightly positive correlation with 10/50. According to Table 2-2, the coefficient of correlation between Q3 and 90/50 is -0.940, while that between Q3 and 10/50 is 0.230, once again showing that a rise in Q3 indicates greater equality in distribution.

For the other independent variables, I followed on the work of Panizza (2002, p. 29), Partridge (1997, pp. 1022-1023), and Perotti (1996, pp. 158-159, 161, 164-171). I obtained data on the average human capital of the labor force from the *Employment Status Survey*: the variable “HighSchool” is the percentage of residents aged 15 or above that graduated high school but did not graduate college or university, while "College" is the percentage of residents aged 15 or above that graduated a 2-year college or a 4-year university. The remaining variables regard the rate of urbanization (where "Urban" is the percentage of residents living in urban areas), the age structure (where "Old" is the percentage of residents aged 65 or above), and the industrial structure (where "Agriculture," "Manufacturing," "FinanInsRealEst," and "Government" are, respectively, the percentages of residents that are employed in agriculture; in manufacturing; in finance, insurance, or real estate; and in government. I obtained the data for "Urban" and "Agriculture" from *Social Indicators by Prefecture*, published by the Statistics Bureau of the Ministry of Internal Affairs and Communications, while the data for "Old," "Manufacturing," "FinanInsRealEst," and "Government" come from the *Population Census*.

3. Estimations

In this section, I explain the results of the estimations. Following on previous researchers (Panizza, 2002, p. 29; Dominicis et al., 2008, p. 659), I used the following estimation equation:

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

In this equation, $Growth_{(t,t+5)}$ is the annual average growth rate of the income of prefectural residents from year t to year t+5, $y_{t,i}$ is the logarithm of the per-capita income of prefectural residents in year t, $DISTRI_{t-1,i}$ is the indicator of income distribution (whether it be the Gini coefficient, the income share of the third quintile, 90/50, or 10/50) in year t-1, and $X_{t,i}$ is the matrix of control variables for prefecture i in year t.

As discussions regarding the Kuznets curve show, because the rate of income growth and the level of income have effects on income distribution, the dependent variables also exert effects in the reverse direction on the independent variables. In this paper, however, I only estimate the effect that income distribution exerts on growth. To make that effect clear, I use variables for the indicators of income distribution that have a time lag of one year.

The control variables X_i are human capital ("HighSchool" and "College"), the rate of urbanization ("Urban"), the age structure ("Old"), and the industrial structure ("Agriculture," "Manufacturing," "FinanInsRealEst," and "Government"). α_i represents the unobservable fixed effect in prefecture i, and $\varepsilon_{t,i}$ represents the disturbance term.

Furthermore, because the independent variables in equation (1) contain a lag term (i.e., income of prefectural residents) for the dependent variables, the estimation equation represents a dynamic panel estimate, and the estimated values for the estimation of the fixed effect are biased (Panizza, 2002, p. 32; Judson & Owen, 1999, p. 9).[2] In addition, the data used consist of six 5-year periods; due to this small

[2] Estimation was carried out using OLS, random-effects, and fixed-effects models, and as a result of F-tests and Hausman tests it became clear that the fixed-effects model was the most preferable of the three estimation models. However, because the estimation values of fixed-effects estimations lack universality, they are not reported in this paper.

number of data periods, the system GMM estimator developed by Arellano and Bover (1995, pp. 48-49) and Blundell and Bond (1998, p. 138) is preferable to the GMM estimator of Arellano and Bond (1991, p. 293). Accordingly, this paper uses the system GMM estimator, as do many recent studies (e.g., Voitchovsky, 2005, pp. 283-286; Kurita & Kurosaki, 2011, pp. 15-16; Castelló-Climent, 2010, p. 295).

The moment conditions used in the system GMM estimator are valid only if there is no serial correlation in the error terms. The results of tests for first-order and second-order serial correlation on the error-lag terms are shown as m1 and m2 in Tables 3-1 through 3-6, and the results show that in these estimations, the moment conditions are valid.

The results of system GMM estimations using the Gini coefficient and Q3 are shown in Table 3-1. In this table, results for estimations carried out without the use of period dummies are shown in the first three columns, and results for estimations carried out using period dummies are shown in the last three columns. In all of the estimations, changes in the Gini coefficient, whenever they were statistically significant, had a negative effect on the growth rate, and changes in Q3 had a statistically significant positive effect on the growth rate.[3]

Hence, both the Gini coefficient and the income share of the third quintile show that equality in income distribution has a positive effect on economic growth. The difference between the two indicators is that while the Gini coefficient reflects overall income distribution, the income share of the third quintile shows the income distribution of the middle class. What is more, in these estimations, aging of the population was controlled for using the variable "Old," and it is worth noting that "Old" had no statistically significant impact on growth.[4]

Table 3-1. System GMM estimations

	Without period dummies			With period dummies		
LogIncome	-0.596	-0.598	-0.599	-0.574	-0.582	-0.575
	(.0632)***	(.0635)***	(.0651)***	(.0676)***	(.0678)***	(.0684)***
Q3		0.413	0.277		0.387	0.274
		(.1900)**	(.3269)		(.1964)**	(.3316)
Gini	-0.125		-0.055	-0.114		-0.048
	(.0610)**		(.1074)	(.0641)*		(.1102)
Old	0.000	0.000	0.000	0.001	0.001	0.001
	(.0014)	(.0014)	(.0015)	(.0020)	(.0020)	(.0020)

[3] In those estimations in which both Q3 and the Gini coefficient were included among the independent variables, both variables became statistically insignificant, regardless of whether period dummies were used. It may be that, because the data used for the Q3 and the data used for the Gini coefficient were both calculated from the annual income for deciles in the *National Survey of Family Income and Expenditure*, multilinearity occurred and they lost their significance.

[4] Ohtake and Sano (2009, pp. 106-108), using prefecture-level panel data and the median voter theorem, showed that aging of the population reduces public spending on education. Therefore, it may be the case that aging of the population reduces the level of human capital ("College") and thereby reduces the rate of economic growth.

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)
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	1.881	1.743	1.809	1.833	1.755	1.735
	(.2380)***	(.2353)***	(.2711)***	(.2480)***	(.2402)***	(.2874)***
m1	-0.406	-0.582	-0.408	-0.794	-0.585	-0.716
m2	-0.031	-0.063	-0.147	-0.174	-0.061	-0.331
N. obs.	188	188	188	188	188	188

N.B.: Figures in parentheses are standard errors.

* indicates the figure is significant at the 10% level, ** indicates significant at 5% level, and *** significant at 1% level.

In the case of Q3, Partridge (1997, p. 1030; 2005, p. 388), using US state-level panel data, found the same positive effect. Partridge (2005, p. 388) explains this result by saying that, as seen in the fact that the income share of the third quintile is larger, when the middle class becomes strong, the rate of long-term economic growth rises.[5]

On this point, Easterly (2001, p. 317) analyzed cross-country data, and he showed additionally that in

[5] Partridge (1997, pp. 1022, 1030), like Persson and Tabellini (1994, pp. 600-601) and Alesina and Rodrik (1994, pp. 465-467), explains the results for Q3 using the median voter theorem. That is, they argue that if the income of the median-income voter — which is included in Q3 — rises, then tax rates chosen for the purpose of redistribution will fall, exerting a positive effect on economic growth. In Japan, however, because the system of public finances is centralized, prefectural tax rates are roughly the same, so whether the median voter theorem is applicable in Japan needs to be verified.

countries where the income share of the middle class is larger, education levels, health levels, infrastructure, economic policy, and political stability are better, and income levels and growth rates are higher. Furthermore, Weinhold and Nair-Reichert (2009, p. 889) showed that in countries with a large middle class, there is more innovation and higher economic growth, while Galor and Zeira (2013, p. 51) concluded that the presence of a large middle class and an increase in the number of people able to receive educational investment are important for economic growth, and Josten (2013, p. 1), in a theoretical study, affirmed that if the middle class shrinks, social capital will also shrink, reducing economic growth rates.

As for the other independent variables, they show that if the income at the start of the period is higher, the growth rate will be lower, and the per-capita income of prefectural residents on a prefecture-by-prefecture basis will converge. In addition, the stock of human capital, as measured by the percentage of college or university graduates, had a positive effect on growth, as expected. And if the percentage of residents employed in manufacturing and in finance/insurance/real estate is high, the growth rate is also high, which may mean that growth rates for income and productivity were high in these industries.

Next, I estimated the impact of the other indicators of income distribution on economic growth. Specifically, I looked at the effect on growth exerted by the ratio of the income share of the highest-income decile to that of the fifth decile (90/50), and the effect on growth exerted by the ratio of the income share of the lowest-income decile to that of the fifth decile (10/50). I did this because Castelló-Climent (2010, pp. 309-314), Voitchovsky (2005, p. 273), and other previous studies made it clear that different parts of the income distribution exert effects on growth that differ from those exhibited by Q3 or the Gini coefficient.

The results of the system GMM estimations are shown in Tables 3-2 and 3-3. Table 3-2 shows the results for estimations carried out without period dummies, and Table 3-3 the results for estimations carried out using period dummies.

In these estimations, the income share of the lowest-income decile has no significant effect on growth, but the income share of the highest-income decile exerts an effect on growth that, when it is statistically significant, is usually positive. In these estimations, as in the previous ones, the Gini coefficient had an effect on growth that, when it was statistically significant, was negative.[6]

Table 3-2. System GMM estimations (without 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	-0.596	-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)**	(.0112)
Gini	-0.125			-0.129	0.045		0.114

[6] As with the case of Q3 and the Gini coefficient, if 90/50 or 10/50 is included along with the Gini coefficient among the independent variables, then these income-distribution variables sometimes become statistically insignificant or change sign. This, too, would be due to multilinearity occurring because each of these variables was calculated from the same annual income for deciles.

	(.0610)**			(.0641)**	(.1454)		(.1834)
Old	0.000	0.000	0.000	0.000	0.000	0.001	0.000
	(.0014)	(.0014)	(.0014)	(.0015)	(.0016)	(.0015)	(.0017)
HighSchool	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001
	(.0005)	(.0005)	(.0005)	(.0005)	(.0006)	(.0006)	(.0006)
College	0.002	0.002	0.002	0.002	0.002	0.002	0.002
	(.0009)**	(.0009)**	(.0008)**	(.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)
Agriculture	0.002	0.002	0.002	0.002	0.002	0.002	0.002
	(.0020)	(.0021)	(.0020)	(.0021)	(.0021)	(.0021)	(.0021)
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)***	(.0062)***	(.0066)***
Government	0.009	0.007	0.011	0.010	0.011	0.010	0.010
	(.0093)	(.0095)	(.0093)	(.0095)	(.0095)	(.0095)	(.0096)
Constant	1.881	1.798	1.881	1.893	1.886	1.877	1.872
	(.2380)***	(.2389)***	(.2355)***	(.2442)***	(.2423)***	(.2409)***	(.2459)***
m1	-0.580	-0.870	-0.310	-0.719	-0.182	-0.350	-0.087
m2	-0.064	0.392	-0.127	0.117	-0.286	-0.006	-0.145
N. obs.	188	188	188	188	188	188	188

N.B.: Figures in parentheses are standard errors.

* indicates the figure is significant at the 10% level, ** indicates significant at 5% level, and *** significant at 1% level.

Table 3-3. System GMM estimations (with 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)
Old	0.001	0.001	0.001	0.001	0.001	0.001	0.001
	(.0020)	(.0020)	(.0020)	(.0020)	(.0020)	(.0020)	(.0021)
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)	(.0009)
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
	(.0098)	(.0101)	(.0098)	(.0102)	(.0100)	(.0102)	(.0102)

Constant	1.833 (.2480)***	1.783 (.2443)***	1.867 (.2456)***	1.834 (.2546)***	1.836 (.2469)***	1.860 (.2505)***	1.780 (.2505)***
m1	-0.794	-0.941	-0.530	-0.974	-0.489	-0.622	-0.415
m2	-0.174	0.456	-0.075	0.019	-0.671	0.068	-0.573
N. obs.	188	188	188	188	188	188	188

N.B.: Figures in parentheses are standard errors.

* indicates the figure is significant at the 10% level, ** indicates significant at 5% level, and *** significant at 1% level.

Hence, the result of these estimations is that equality at the top income level and overall equality have a positive effect on growth. However, in previous studies that used cross-country panel data (Castelló-Climent, 2010, pp. 309-311; Voitchovsky, 2005, p. 273), the result obtained was that the effect on growth exerted by equality of income among high-income individuals was negative, the opposite of the result obtained in this paper.

Finally, in order to test the robustness of these results against other estimation methods and instrumental variables, in Tables 3-4 through 3-6 I show estimation results obtained using the Arellano-Bond GMM estimator. In these three tables, it is evident that the estimated values for the coefficients of the four income-distribution indicators — the Gini coefficient, Q3, 90/50, and 10/50 — have the same sign as in the system GMM estimations. Although the estimated values for the coefficients of some of the control variables do differ, the main outcome, i.e., that equality in income distribution has a positive impact on economic growth, is the same for both estimators, indicating that the estimation results are robust.

In this paper, I found that in Japan, equality in income distribution has exerted a positive effect on economic growth, yet there is need for analysis to find out how — i.e., via what channels — equality exerts an influence on economic growth. As a next step, in future research I intend to carry out estimations regarding channels that act by way of public spending on education, college enrollment rates, capital accumulation, etc.

4. Conclusion

In this paper, I used Japanese prefecture-level panel data from 1979 through 2010 to analyze what sort of effect income distribution had on economic growth. It became clear that in system GMM estimation and Arellano-Bond GMM estimation alike, equality in income distribution — as measured by Gini coefficients, etc. — exerted a statistically significant positive effect on economic growth over five-year periods.

It also became clear that the effect that distribution exerts on growth varies depending on the income level. Specifically, in Japan, equality in income distribution in the high-income brackets and the middle brackets had a positive effect on growth, but income distribution in the low-income brackets had no statistically significant effect on growth. These estimation results are consistent with those obtained in earlier studies such as those by Piketty (2014, p. 276) and Voitchovsky (2005, p. 273), so the results can be considered robust.

Table 3-4. Verification of robustness: Arellano-Bond GMM estimation

Without period dummies With period dummies

	Without period dummies			With period dummies		
LogIncome	-0.515	-0.552	-0.584	-0.740	-0.739	-0.741
	(.038)***	(.041)***	(.048)***	(.050)***	(.047)***	(.048)***
Q3	0.208		0.396	0.297		0.158
	(.1519)		(.2284)*	(.1592)*		(.2227)
Gini		-0.013	0.067		-0.094	-0.057
		(.0388)	(.0606)		(.0471)**	(.0663)
Old	-0.005	-0.004	-0.003	-0.003	-0.003	-0.003
	(.001)***	(.001)***	(.001)**	(.001)**	(.001)**	(.001)**
HighSchool	0.000	0.000	-0.001	-0.0013	-0.0011	-0.0011
	(.0003)	(.0003)	(.0002)*	(.0006)**	(.0006)*	(.0006)*
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)	(.0005)	(.0005)
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)***
m1	0.751	0.563	0.734	0.614	0.366	0.516
m2	0.239	0.023	0.088	0.402	0.136	-0.009
N. obs.	188	188	188	188	188	188

N.B.: Figures in parentheses are robust standard errors.

* indicates the figure is significant at the 10% level, ** indicates significant at 5% level, and *** significant at 1% level.

Table 3-5. Verification of robustness: Arellano-Bond GMM estimation (without 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	-0.618	-0.601	-0.618	-0.629	-0.616	-0.616	-0.628
	(.063)***	(.063)***	(.062)***	(.065)***	(.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)**		(.1863)

Old	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	(.0014)	(.0014)	(.0014)	(.0015)	(.0015)	(.0014)	(.0016)
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)
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)***	(.259)***	(.250)***	(.258)***	(.260)***	(.256)***	(.262)***
m1	0.563	0.263	0.783	0.248	0.943	0.687	0.849
m2	0.023	0.501	0.054	0.269	-0.180	0.178	0.061
N. obs.	141	141	141	141	141	141	141

N.B.: Figures in parentheses are robust standard errors.

* indicates the figure is significant at the 10% level, ** indicates significant at 5% level, and *** significant at 1% level.

Table 3-6. Verification of robustness: Arellano-Bond GMM estimation (with 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)
Old	-0.003	-0.004	-0.003	-0.004	-0.003	-0.003	-0.003
	(.0014)**	(.0015)**	(.0015)**	(.0015)**	(.0015)**	(.0015)**	(.0015)**
HighSchool	-0.0011	-0.0013	-0.0012	-0.0011	-0.0011	-0.0012	-0.0011
	(.0006)*	(.0006)**	(.0006)**	(.0006)*	(.0006)*	(.0006)**	(.0006)*
College	-0.001	-0.001	-0.001	-0.001	0.000	-0.001	-0.001
	(.0006)	(.0006)	(.0006)	(.0007)	(.0005)	(.0006)	(.0007)
Urban	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	(.0005)	(.0005)	(.00058)	(.0005)	(.0005)	(.0005)	(.0005)
Agriculture	0.001	0.001	0.001	0.001	0.001	0.001	0.001
	(.0011)	(.0012)	(.0011)	(.0011)	(.0011)	(.0011)	(.0012)
Manufacturing	0.002	0.002	0.002	0.002	0.002	0.002	0.002
	(.0009)**	(.0009)**	(.0009)**	(.0010)*	(.0010)**	(.0009)**	(.0010)*
FinanInsRealEst	0.006	0.006	0.007	0.006	0.007	0.007	0.006

	(.0051)	(.0054)	(.0053)	(.0054)	(.0051)	(.0053)	(.0053)
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)***
m1	0.366	0.148	0.627	0.125	0.677	0.600	0.571
m2	0.136	0.556	0.300	0.282	-0.417	0.360	-0.350
N. obs.	188	188	188	188	188	188	188

N.B.: Figures in parentheses are robust standard errors.

* indicates the figure is significant at the 10% level, ** indicates significant at 5% level, and *** significant at 1% level.

References

Alesina, Alberto, and Rodrik, Dani “Distributive Politics and Economic Growth,” Quarterly Journal of Economics, 1994,109(2), pp.465-490.

Arellano, M., and S. Bond “Some Tests of Specification for Panel Data: Monte Carlo Evidence and Application to Employment Equations,” Review of Economic Studies,1991, 58, pp.277-297.

Arellano, M., and O. Bover “Another look at the instrumental-variable estimation of error-components models,” Journal of Econometrics, 1995, 68, pp.29-52.

Barro, Robert J. “Inequality and Growth in a Panel of Countries,” Journal of Economic Growth, 2000, 5, pp.5-32.

Blundell, R., and S. Bond “Initial conditions and moment restrictions in dynamic panel data models,” Journal of Econometrics, 1998, 87, pp.115-143.

Castello-Climent, Amparo “Inequality and growth in advanced economies: an empirical investigation,” Journal of Economic Inequality, 2010, 8, pp.293-321.

Cingano, Federico “Trends in Income Inequality and its Impact of Economic Growth,” OECD Social, Employment and Migration Working Papers, 2014, No. 163.

Deininger, K., and L. Squire “A New Data Set Measuring Income Inequality,” World Bank Economic Review,1996, 10, pp.565-591.

Dominicis, L., R. J. M. Florax, and H. L. F. Groot. 2008. “A Meta-Analysis on the Relationship between Income Inequality and Economic Growth.” Scottish Journal of Political Economy 55(5): 654-682.

Easterly, William. “The Middle Class Consensus and Economic Development,” Journal of Economic Growth, 2001, 6: 317-335.

Foellmi, Reto and Josef Zweimuller “Income Distribution and Demand-Induced Innovations,” Review of Economic Studies, 2006, 73, pp.941-960.

Forbes, Kristin “A Reassessment of the Relationship Between Inequality and Growth,” American Economic Review, 2000, 90(4), pp.869-887.

Galor, Oded and Joseph Zeira “Income Distribution and Macroeconomics,” Review of Economic Studies, 1993, 60, pp.35-52.

Halter, Daniel, M. Oechslin, and J. Zweimullwer “Inequality and growth: the neglected time dimension,” Journal of Economic Growth, 2014, 19, pp.81-104.

Josten, S.D. 2013. "Middle-Class Consensus, Social Capital and the Fundamental Causes of Economic Growth and Development." Journal of Economic Development 38(1): 1-26.

Judson, R., and A. Owen "Estimating Dynamic Panel Data Models: A Guide for Macroeconomists," Economics Letters, 1999, 65, pp.9-15.

Kobayashi, K. (2016, February 22, morning ed.). Kakusa kakudai, seichō ni akueikyō? [Does a widening income gap have an adverse effect on growth?]. *Nihon Keizai Shimbun*.

Kurita, Kyosuke, and Takashi Kurosaki "Dynamics of Growth, Poverty, and Inequality: A Panel Analysis of Regional Data from Thailand and the Philippines," Asian Economic Journal, 2011, 25(1), pp.3-33.

Li, Hongyi, and Heng-fu Zou "Income Inequality is not Harmful for Growth: Theory and Evidence," Review of Development Economics, 1998, 2(3), pp.318-334.

Ohtake, F. (2005). *Nihon no fubyōdō* [Inequality in Japan]. Tokyo: Nihon Keizai Shimbun.

Ohtake, F., & Sano, S. (2009). Jinkō kōrei-ka to gimu kyōiku-hi shishutsu [Impacts of population aging on public education in Japan]. *Osaka Economic Papers 59*(3), 106-130.

Oshio, T., Tajika, E., & Fukawa, T. (2006). *Nihon no shotoku bunpai: kakusa kakudai to seisaku no yakuwari* [Income distribution in Japan: growing disparity and the role of policy]. Tokyo: University of Tokyo Press.

Ostry, Jonathan D., Andrew Berg, and Charalambos G. Tsangarides "Redistribution, Inequality, and Growth," IMF Staff Discussion Note 2014.

Panizza, Ugo "Income Inequality and Economic Growth: Evidence from American Data," Journal of Economic Growth, 2002, 7, pp.25-41.

Partridge, Mark D. "Is Inequality Harmful for Growth? Comment," American Economic Review, 1997, 87(5), pp.1019-1032.

Partridge, Mark D. 2005. "Does Income Distribution affect U.S. State Economic Growth?" Journal of Regional Science 45(2): 363-394.

Perotti, Roberto "Growth, Income Distribution, and Democracy: What the Data Say," Journal of Economic Growth, 1996, 1, pp.149-187.

Persson, Torsten, and Guide Tabellini "Is Inequality Harmful for Growth?" American Economic Review, 1994, 84(3): pp.600-621.

Piketty, T. (2014). *21-seiki no shihon* [Capital in the 21st century]. Tokyo: Misuzu Shobo.

Simoes, Marta C. N., Joao A. S. Andrade, and Adelaide P. S. Duarte "A regional perspective on inequality and growth in Portugal using panel cointegration analysis," International Economic Policy, 2013, 10, pp.427-451.

Tachibanaki, T. (2006). *Kakusa shakai: nani ga mondai na no ka* [Social disparity: why is it a problem?]. Tokyo: Iwanami Shoten.

Voitchovsky, Sarah "Does the Profile of Income Inequality Matter for Economic Growth?" Journal of Economic Growth, 2005, 10, pp.273-296.

Weil, David N. Economic Growth, International Edition, Pearson Education, Inc., 2013.

Weinhold, D. and U. Nair-Reichert. 2009. "Innovation, Inequality and Intellectual Property Rights," World Development 37(5): 889-901.