Female Labor Participation Behavior in Japan: Theory and Evidence

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Abstract:
A general equilibrium model is constructed to explain an empirical evidence of the linkage between female labor participation and the business cycle in Japan. We present a conjecture on why the discouraged worker effect has become weak in recent Japan. The main implication is that income inequality affects the movement of female labor supply, and widening income inequality is a possible cause that leads to the weak correlation between female labor participation behavior and the business cycle.

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Key words: female labor participation, business cycle, housework, income inequality.

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Ⅰ. Introduction

In the past recessions, the number of discouraged workers was large in Japan, and women made up a large share of discouraged workers. The female labor participation rate tended to move pro-cyclically to the business cycle. That is, the female labor participation rate rose when the economy expanded and fell in a recession. Therefore, the unemployment rate remained substantially lower than that of other industrialized countries[1].

In the current prevailing economic stagnation, however, the female workers tend to stay in the labor market and the unemployment rate is rising rapidly. Here, one question arises. In the past recessions, female workers had a tendency to leave the labor market and engage in housework. Why has the net discouraged worker effect become smaller in the recent recession? In other words, what causes a change in the balance between the added worker effect and the discouraged worker effect in the recent stagnation in Japan?

The trend of female labor supply has been analyzed in many researches. Shimada and Higuchi (1985) and Tachibanagi and Sakurai (1991) provided empirical analyses using Japanese macroeconomic data. Most of the researches about the female labor supply are focused on only the supply side of female labor while female labor supply is determined not only by each household decision but also by the wage level offered by the production sector. In the previous researches, the demand side is rarely examined with a few exceptions including Benhabib et al. (1991) and Rios-Rull (1993). In this paper, we combine both the production sector and the household decision to analyze the relationship between the business cycle and female labor supply in a general equilibrium model as the benchmark of the empirical works. Then, using a general equilibrium model, the mechanism of female labor supply can be simply analyzed and an implication of the linkage between female labor participation and the business cycle is explicitly provided in this paper. The model in this paper shows that the role of housework in each household determines which effect, the discouraged or the added worker effect, dominates the economy.

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[1] See OECD (1993).

We construct a model that shows the relationship between female labor participation and the growth of the economy. One production sector with two factors is considered in this paper, male and female labors. The framework heavily depends on the analysis provided by Wong (1995) that showed how the growth of various factors contributes to changes in the economic environment in a small and open economy. We examine the household decision of female labor supply by using the CES utility function that was shown in Zabalza (1983), considering each household preference between housework and labor market participation of women. A distinguishing feature of using the CES function is that it allows for an easier empirical analysis, as stated in Zabalza.

However, it is not sufficient to focus on the linkage between female labor participation and the business cycle to explain the recent change in Japanese female labor participation behavior. We notice that the income level of each household that affects the decision of female labor participation is different from the business cycle that represents the aggregate movement of the economy. Swings of the business cycle do not necessarily lead to increases or decreases in the income level of each household in the equal growth rate. It is worth introducing the income distribution into the analysis in order to investigate the issue of female labor participation and the business cycle theoretically and empirically.

The most important contribution in this paper is that the income inequality is a possible source of the recent change in female labor supply in Japan theoretically, and our empirical investigation using Japanese macroeconomic data supports the theoretical conjecture. This paper suggests that the household preference, which is determined by the income level of each household, may have caused the smaller discouraged worker effect in the recent recession. This indicates that the widening income distribution is a cause that the net effect of unemployment has been changed from past recessions and the recessions in 1990s[2].

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[2] Tachibanaki(1998) claimed that there was increase in income inequality in the recent Japanese economy, partly due to the asset bubble occurred in the late 1980's. Since the controversy about the widening income inequality exists, this paper considers the cross-regional difference in the income distribution and female labor supply to examine the theoretical framework.

The rest of the paper is organized as follows. In Section 2, we explore a basic model and its implications to describe the tendency of female labor supply in Japan. Section 3 demonstrates a statistical estimation by using Japanese cross-regional aggregate data to examine adequacy of the theoretical conjecture described in Section 2. The concluding remarks and suggestions of further research are given in Section 4.

Ⅱ. The Model

The economy is endowed with fixed amounts of two types of homogeneous labors, labor 1 and labor 2. Denote the endowments of labor 1 and 2 by L_1 and L_2 respectively. Labor 1 is thought to be a highly skilled worker, and labor 2 is thought to be a low-skilled worker, mostly consisting of female workers. All highly skilled workers are assumed to participate in the labor market, and low-skilled workers choose labor market participation or housework.

The aggregate production function is given in the form of Cobb-Douglas function. That is,

$$Q = AL_1^{\theta} L_2^{1-\theta}, \qquad 0<\theta<1, \qquad (1)$$

where Q is aggregate output, and A is the productivity which represents the level of technology, knowledge capital, and so on. Productivity is treated as an exogenous parameter.

It is assumed that all markets in this economy are perfectly competitive, and prices are perfectly flexible. Let us denote the wage rate of labor i by w_i, and the equilibrium conditions for the two types of labor become as follows.

$$w_1 = \theta Q/L_1 ,$$
$$w_2 = (1-\theta) Q/L_2 . \qquad (2)$$

Under perfect competition, firms producing positive outputs earn zero economic profit, which means,

$$Q = w_1 L_1 + w_2 L_2 . \qquad (3)$$

Let $\hat{y} \equiv dy/y$ represent the rate of growth of any variable y. Differentiating equation (1), (2), and (3), and rearranging terms allow us to obtain

$$\hat{A} = \theta \hat{w}_1 + (1-\theta)\hat{w}_2 , \qquad (4)$$

Taking into account that the elasticity of technical substitution of the aggregate

production function is equal to -1, the change in each wage rate can be written as follows;

$$\hat{w}_1 = \hat{A} - (1-\theta)(\hat{L}_1 - \hat{L}_2), \qquad (5)$$

$$\hat{w}_2 = \hat{A} + \theta(\hat{L}_1 - \hat{L}_2). \qquad (6)$$

The economy under analysis has continuum households measured by one. Each household has $\bar{L}_1$, the amount of labor 1, and $\bar{L}_2$, the amount of labor 2. Each household derives utility from family income (or goods consumption) and housework. Define I as the family income and h as the hours of housework by labor 2. Each household's preference is given by

$$U_i = \left[I_i^{\varepsilon} + \frac{h_i^{\varepsilon}}{\alpha_i} \right]^{\frac{1}{\varepsilon}}, \qquad \alpha_i > 0, \quad \varepsilon < 1, \text{ for all i}, \qquad (7)$$

where α_i and ε are parameters. The parameter α_i expresses the weight on housework relative to income, while ε determines the elasticity of substitution of the utility function. Usually, preference between consumption and housework is strongly affected by the wealth level of the household. In this model the parameter α_i is assumed to represent the scale of household i's income level[3]. Convexity of the indifference curve requires that $\varepsilon < 1$, while negative slope is assured if $\alpha_i > 0$. The hours for housework are interpreted as the hours for cooking or doing laundry instead of purchasing meals or using laundry services in the market, for example. The budget constraint of each household can be written as follows.

$$I_i \le w_1 \bar{L}_1 + w_2(\bar{L}_2 - h_i). \qquad (8)$$

To simplify the problem, saving is not considered in this economy. Labor 1 workers are considered to be firmly attached to the labor force over time, and labor 2 workers, who are low skilled and mostly consist of females, are considered to allocate their time to work or to do housework. These assumptions are imposed to capture the household decision easily. The maximization of (7) subject to (8) with respect to h_i and I_i gives the resource allocation function of each household

[3] This assumption is reinforced by the statement of Pissarides (2000, p.170).

$$\frac{h_i}{I_i} = (\alpha_i w_2)^{\frac{1}{\varepsilon-1}}. \qquad (9)$$

The behavior of labor 2 is characterized in terms of a critical housework-income ratio. A labor 2 individual will participate in the labor market if the housework-income ratio is smaller than $\bar{L}_2 / w_1 \bar{L}_1$.

Let us introduce a stochastic variation of the model in the parameter α_i. Since α_i must be a positive parameter, it is defined as

$$\alpha_i = \exp(X), \qquad \forall i \quad (10)$$

where X is a random variable, which is assumed to be normally distributed with zero mean and variance σ^2, $X \sim N(0, \sigma^2)$. Now, denoting $\alpha = \{\alpha_i\}$, α can also be thought as the parameter which expresses the income distribution. In this paper, the definition of asset includes human capital as well as non-human capital such as money and land. It is natural to consider the asset distribution to analyze the decision of the labor supply in each household, because usually, the preference of each household is influenced by its wealth, and the decision of labor 2 to engage in housework or to work depends on the levels of household incomes and their own assets.

A labor 2 individual will not participate in the labor market if her housework-income ratio, assuming that the wage rates are given for each household, is bigger than $\bar{L}_2 / w_1 \bar{L}_1$. Therefore, the non-participation rate of labor 2, denoting P(NP), can be expressed as follows.

$$P(NP) = prob\left[(h_i / I_i) \geq (\bar{L}_2 / w_1 \bar{L}_1)\right]. \qquad (11)$$

Substituting (9) and (10) into (11), the non-participation rate can be written as

$$P(NP) = F(Y_{NP}), \qquad (12)$$

where $F(\cdot)$ is the standardized cumulative normal distribution function, and Y_{NP} is defined as

$$Y_{NP} = \frac{1}{\sigma}\left[(1-\varepsilon)\ln w_1 + (1-\varepsilon)\ln \bar{L}_1 - \ln w_2 - (1-\varepsilon)\ln \bar{L}_2\right]. \qquad (13)$$

Then, the change in the non-participation rate can be written as follows:

$$dP(NP) = f(Y_{NP})\frac{1}{\sigma}\{(1-\varepsilon)\hat{w}_1 - \hat{w}_2\},$$

where $f(Y) = dF(Y)/dY$. From the assumption of $\varepsilon<1$, it is easy to see that the

non-participation rate is increasing in w_1 and decreasing in w_2. Now we can investigate the relationship between the swings in the business cycle and the supply of labor 2 by combining the production sector and the household sector.

To examine the linkage between the growth of productivity in the economy and the participation rate of labor 2, we have to calculate the aggregate labor supply. The aggregate supply of labor 1 is $\bar{L}_1$ because all the individuals who are labor 1 are thought to spend all of their time working, that is, $\hat{L}_1 = 0$ in this model. The aggregate amount of supply of labor 2 should be equal to demand in the production sector, and it is given as follows,

$$L_2 = \int_{i \in i_{NP}} \left(\bar{L}_2 - h_i\right) di \,, \qquad (14)$$

where i_{NP} is defined as $i_{NP} = \left\{ i \middle| \left(h_i / I_i\right) \geq \left(\bar{L}_2 / w_1 \bar{L}_1\right) \right\}$. Using Leibniz' rule, the growth of aggregate supply of labor 2 is measured by,

$$\begin{aligned} dL_2 &= -\int_{i \in i_{NP}} dh_i\big|_{\alpha}\, di \\ &= \int_{i \in i_{NP}} \left[\frac{w_2\left(\bar{L}_2 - h_i\right)}{w_1 \bar{L}_1 + w_2 \bar{L}_2} \left(\hat{w}_1 - \hat{w}_2\right) - \left(\hat{w}_1 - \frac{1}{1-\varepsilon} \hat{w}_2 \right) \frac{I_i}{w_1 \bar{L}_1 + w_2 \bar{L}_2} \right] h_i di \,. \end{aligned} \qquad (15)$$

By using (5), (6), and (15), we have

$$\hat{L}_2 = C_0 \cdot \frac{\varepsilon}{1-\varepsilon} \hat{A}, \qquad (16)$$

where $C_0 \equiv \dfrac{\displaystyle\int_{i \in i_{NP}} \frac{I_i h_i}{\left(w_1 \bar{L}_1 + w_2 \bar{L}_2\right) L_2} di}{1 - \displaystyle\int_{i \in i_{NP}} \frac{w_2\left(\bar{L}_2 - h_i\right) h_i}{\left(w_1 \bar{L}_1 + w_2 \bar{L}_2\right) L_2} di + \frac{1-\varepsilon(1-\theta)}{1-\varepsilon} \int_{i \in i_{NP}} \frac{I_i h_i}{\left(w_1 \bar{L}_1 + w_2 \bar{L}_2\right) L_2} di}$, and $C_0 > 0$.[4] Also, the linkage between the non-participation rate of labor 2 and the

[4] Remember $0 < \theta < 1$ and $\varepsilon < 1$. In this case, $0 < \dfrac{1-\varepsilon(1-\theta)}{1-\varepsilon} < 1$ and

$$\int_{i \in i_{NP}} \frac{w_2\left(\bar{L}_2 - h_i\right) h_i}{\left(w_1 \bar{L}_1 + w_2 \bar{L}_2\right) L_2} di = \int_{i \in i_{NP}} \frac{w_2\left(\bar{L}_2 - h_i\right)\left(h_i - \bar{L}_2 + \bar{L}_2\right)}{\left(w_1 \bar{L}_1 + w_2 \bar{L}_2\right) L_2} di$$

growth of productivity can be solved by using (15) and (16), that is,

$$dP(NP) = -\frac{\varepsilon}{\sigma} \cdot C_1 \cdot \hat{A}, \qquad (17)$$

where $C_1 = f(Y_{NP})\left[1 - \int_{i \in i_{NP}} \frac{w_2(\bar{L}_2 - h_i)h_i}{(w_1\bar{L}_1 + w_2\bar{L}_2)L_2} di\right] \Big/ \int_{i \in i_{NP}} \frac{I_i h_i}{(w_1\bar{L}_1 + w_2\bar{L}_2)L_2} di$, $C_1 > 0$.

Equation (17) describes the response of the household sector to a fluctuation of the economy. Considering both the demand side and the supply side of female labor, we can evaluate a simple relationship between female labor participation and the productivity growth in the economy. The relationship is affected by the parameters ε and σ. In the case where 0< ε <1, goods consumption and housework are substitutes, and the positive growth rate of the productivity in the economy leads to a increase in the labor 2 involving in the labor market. This is called the discouraged worker effect. If ε is negative, and goods consumption and housework are less substitutes for the household, the female labor participation rate moves opposite to the productivity growth. This is known as the added worker effect. In addition to that, a smaller σ enlarges the influence of the productivity growth upon the female labor participation rate. This suggests that the participation rate will change more when σ is small and less if σ is large. This parameter represents the degree of the income distribution in this model. For instance, when ε is positive, the discouraged worker effect becomes large in a recession if the income inequality is slight (σ is small), and in contrast to that, the discouraged worker effect becomes small if the income distribution is widely spread.

The characterizations of the relationship between labor supply and the productivity growth described above comes from the following mechanism of household

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$$= -\int_{i \in i_{NP}} \frac{w_2(\bar{L}_2 - h_i)^2}{(w_1\bar{L}_1 + w_2\bar{L}_2)L_2} di + \frac{w_2\bar{L}_2}{w_1\bar{L}_1 + w_2\bar{L}_2}.$$

Thus, C_0 should be positive in this model.

However, an exception would arise if the elasticity of technical substitution of the production function is very small. That is, the production function is different from the one in this paper. In that case, there is a set of the elasticity of technical substitution and the elasticity of substitution between consumption and housework that causes the coefficient C_0 to be negative.

utility derivation. In this model, income is consumed for goods consumption only and saving is not considered. The consumption-housework ratio represents the labor resource allocation in the household over the business cycle. If ε is positive and goods consumption and housework are substitutes for the household, the consumption-housework ratio will decline when the wage level falls compared to the price level of consumption goods in a market when the economy is in the recession. As the result, the participation rate of labor 2 decreases, and the labor force moves toward the household sector to equalize the marginal utilities. Therefore, the discouraged worker effect appears. However, if ε is negative, sustaining the income level is important when the economy is in the recession. Low-skilled workers tend to participate in the labor market rather than to conduct housework, and the consumption-housework ratio increases and the added worker effect appears in this case.

Notably, the parameter σ, which is interpreted as the income inequality, affects the participation behavior of labor 2. When the income distribution is widely spread, the net effect of the productivity growth upon the participation rate of labor 2 is small and vice versa. According to equation (17), σ determines the scale of the impact by the business fluctuation on labor 2. The parameter σ can be considered as a multiplier that implies the relationship between the business cycle and participation of labor 2. That is, the smaller σ enlarges the net effect of the productivity growth on the participation rate, and the participation decision is not strongly influenced by a productivity shock when σ is large. This characterization can be explained by the following mechanism. The threshold that determines the labor participation decision of labor 2 becomes narrow when the income inequality is large. The productivity shock does not have an impact strong enough to change the participation behavior of labor 2 if the income distribution is widely spread. For instance, a rich household remains rich and a poor household remains poor even if there is a productivity shock in the economy that causes the changes in wage levels of both labor 1 and labor 2, and it is exactly middle class households that are strongly influenced by the economic situation. There is a small number of households that reconsiders labor 2's behavior depending on the business fluctuation when the income distribution is large. In

contrast to that, many workers who are labor 2 may swing between engaging in housework and participating in the labor market when the income distribution is small and there are many middle class households in the economy. Also, it should be carefully noted that not σ but ε determines which effect, either the discouraged worker effect or the added worker effect, dominates the economy, and σ is the parameter that enlarges the net effect which is determined by ε .

The model has implications about empirical evidence of the recent change in the linkage between female labor supply and the business cycle. The theoretical framework suggests that the widening income distribution may be a possible cause that has lead to the recent change in female labor participation behavior, in which female labors tend to remain in the labor market despite the economic stagnation. The widening income inequality has caused many middle class households to be poorer, which forces many female labor to be involved in the labor market even when the business cycle moves downward in the economy. The model also suggests that the substitution between goods consumption and housework has changed from the past recessions to the current recession, which may be a cause that led the added worker effect to exceed the discouraged worker effect in the recent recession. This indicates that goods consumption and housework are getting less substitutive in the economy. For example, in the past, a housewife sewed a shirt instead of purchasing one in the market, but nowadays sewing a shirt is no more a part of housework. As a result, there is no choice but to go to a shop to look for a shirt. To sustain the income level is more valuable than to engage in housework in an economic stagnation in recent Japan.

Ⅲ Estimation of the female labor force participation rate

On the basis of the theoretical model constructed in the previous section, we proceed to investigate the effect of income distribution on the female labor force participation rate. The estimation period is 1990 to 1999. There were major revisions of the "Equal Employment Opportunity Law Between Men and Women" in 1985 and 1999, and by limiting the estimation period to the 1990s, we hope to avoid that the estimation results are heavily influenced by these large institutional changes. Panel data for nine Japanese regions (Hokkaido, Tohoku, Kanto, Hokuriku, Tokai,

Kinki, Chugoku, Shikoku and Kyushu), over the ten-year period is the basis for the empirical investigation.[5]

The dependant variable in our model is the log of the change in the female participation ratio, denoted by $LDFP_{it}$. The ratio is calculated as the female labor force divided by the female population aged 15 and older.[6]

We consider three dependant variables: the log of the income distribution (denoted by $LGINI_{it}$), the year-on-year change in the job openings/applications ratio (denoted by $DJOB_{it}$), and the annual macro-economic Total Factor Productivity (TFP) growth rate (denoted by $GTFP_t$). We calculated Gini coefficients for each region using data from the *Survey of Household Economy* (*sic*) and use these coefficients as proxies for the income distribution in the regions. The job openings/applications ratio in each region is calculated using data from the *Report on Employment Service* (*sic*) and is included in our model to capture short-run variations in the demand-supply gap. The TFP growth rate is directly taken from Hayashi & Prescott (2002).[7] Our basic model including these variables is given by the following equation:

$$LDFP_{it} = \alpha_i + LGINI_{it} + DJOB_{it} + GTFP_t$$

Based on the theoretical model presented in the previous section, we expect a negative income distribution coefficient. In addition to that, it is assumed to obtain positive coefficients on both the job openings/applications ratio and the TFP growth rates, according to the previous researches.[8] We estimated three types of equations, as shown in table 1, and all equations are estimated using both the fixed ("within") and the random effect methods. The last column in the table gives Hausman test results and from these results, we can conclude that the random effect method is the appropriate estimation. All the coefficients have the expected signs, and notably, the

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[5] A list of the prefecture included in each of the regions and more details of the data used in the model can be found in the Appendix.

[6] Because we cannot take the log of a negative number, 1 is added to all the calculated changes in the ratios.

[7] This is the macro TFP growth rate, since regional TFP growth rates are not available.

[8] See Shimada and Higuchi (1985), Tachibanagi and Sakurai (1991), and Cain (1966).

coefficients on income distribution are statistically significant. Hence, we conclude that the widening income distribution had a negative impact on the female labor participation ratio in Japan during the 1990s.

Table 1 Estimation of female labor supply functions

Equation number	α_i	$LGINI_{it}$	$DJOB_{it}$	$GTFP_t$	$GTFP_{t-1}$	Hausman test (CHISQ)
1 f		-0.002554	0.010104			1.92
(fixed effect)		(-0.21)	(2.04)			
1 r	-0.02025	-0.0128	0.01234			
(random effect)	(-2.08)	(-2.11)	(2.74)			
2 f		-0.002351	0.007122	0.000413		1.99
(fixed effect)		(-0.20)	(1.08)	(0.69)		
2 r	-0.01914	-0.011965	0.010634	0.00023		
(random effect)	(-1.85)	(-1.84)	(1.86)	(0.41)		
3 f		-0.002457	0.005521		0.001391	2.40
(fixed effect)		(-0.22)	(1.14)		(3.40)	
3 r	-0.0188	-0.011106	0.008002		0.001344	
(random effect)	(-1.85)	(-1.76)	(1.79)		(3.32)	

1. The dependent variables is the log of change in the female labor participation ratio. 2.The values in the parenthese are the associated t-values .

Ⅳ. Concluding remarks

This paper has provided a theoretical and empirical analysis on female labor supply and the growth of productivity in a closed economy to analyze the empirical facts on the recent change in female labor participation. Income inequality is the key to understanding the linkage between female labor participation behavior and the swings of the economy.

Recently in Japan, the labor participation rate, particularly the female labor participation rate, has not declined since the 1990s. This indicates that the discouraged worker effect has not strongly dominated in the economy, unlike from the previous recessions. According to the model provided in this paper, it may be possible to state that the widening income distribution is a cause to weaken the discouraged worker effect in the recent prevailing recession.

The model is estimated by using Japanese cross-regional data on participation, on the business cycle, and on income inequality in the 1990s to provide a check on the result obtained in the theoretical framework. The empirical analysis shows that small income inequality enlarges the discouraged worker effect. This indicates that the

theoretical conjecture is valid in understanding the recent change in female labor participation behavior.

The theoretical framework provided in this paper will help us to understand female labor supply and the recent high unemployment rate in Japan. Hopefully the model constructed in this paper will be useful in understanding the issues of the productivity growth and female labor participation behavior in other industrialized countries.

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Appendix

Female Labor Force Participation Ratio

= (Female Labor Force by region)/(Female Population aged 15 years and older by region)

Data Source: *Labour Force Survey*, Statistics Bureau, Ministry of Public Management, Home Affairs, Posts and Telecommunications.

Job Openings/Applications Ratio

= (Active job openings by region)/(Active applications by region)

Data Sources:

・data for 1993-2001: annual (Fiscal year) data from *Yearbook of Labour Statistics,* Ministry of Health, Labour and Welfare.

・data for 1989-1992 ：annual (calendar year) data from *Todofuken no Kisotokei 1998 (Basic Statistics by Prefecture)*", Statistical Information Institute for Consulting and Analysis.

・Fiscal year data for 1989-1992 is converted into calendar year data by applying the following equation:

$X_{calendar}(t) = X_{fiscal}(t-1)*(9/12) + X_{fiscal}(t)*(3/12)$.

Gini Coefficient

=1－0.2*(2*A+ 2*B + 2*C + 2*D + 1)

where A = average annual earnings within the income category Ⅰ÷ sum of average annual earnings of all income groups;

B = sum of average annual earnings within the income categories Ⅰ and Ⅱ ÷ sum of average annual earnings of all income groups;

C = sum of average annual earnings within the income categories Ⅰ, Ⅱ, and Ⅲ ÷ sum of average annual earnings of all income groups;

D = sum of average annual earnings within the income categories Ⅰ, Ⅱ, Ⅲ, and Ⅳ ÷ sum of average annual earnings of all income groups.

Data Source: *Survey of Household Economy*, Statistics Bureau, Ministry of Public Management, Home Affairs, Posts and Telecommunications.

TFP growth rate

Data Source: *Hayashi & Prescott (2002)*

Regional Classification

Region	Prefectures
Hokkaido	Hokkaido
Tohoku	Aomori, Iwate, Miyagi, Akita, Yamagata, Fukushima
Kanto	Saitama, Chiba, Tokyo, Kanagawa, Ibaragi, Tochigi, Gunma, Yamanashi, Nagano
Hokuriku	Niigata, Toyama, Ishikawa, Fukui
Tokai	Gifu, Shizuoka, Aichi, Mie
Kinki	Shiga, Kyoto, Osaka, Hyogo, Nara, Wakayama
Chugoku	Tottori, Shimane, Okayama, Hiroshima, Yamaguchi
Shikoku	Tokushima, Kagawa, Ehime, Kochi
Kyushu	Fukuoka, Saga, Nagasaki, Kumamoto, Oita, Miyazaki, Kagoshima, Okinawa

Note) In our calculation of the Gini coefficient for Kyushu, we did not include data for Okinawa prefecture because we were unable to find an appropriate weight for the aggregation.