Present at the Fifteenth International Input-Output Conference
to be held at Renmin University in Beijing, China P.R., June 27- July 1, 2005

The Influence on Inequality of Compensation of Employee by Change in Industrial Structure

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1. Introduction

It has been said in postwar Japan that income was distributed equally. In 1998, Toshiaki Tachibanaki, professor of Kyoto University, published a book entitled, *Economic Discrepancy in Japan*, which indicated that income inequality has been widened in Japan in recent years. Since then, lively discussion emerged that whether income inequality of Japan is widened or not. Meanwhile, the industrial structure has changed due to the deindustrialization or "hollowing out" accompanying a strong yen after the Plaza Accord in 1985. Although this discussion of income inequality attracts general public in Japan, and change in industrial structure brought about both job loss and job creation, no one has discussed which change in industrial structure had influenced over the income inequality. By using Japanese Input Output Tables from 1970 to 2000, this paper will examine the influence of change in industrial structure on the inequality of compensation of employee. Here, the inequality of compensation of employee is regarded as proxy of income inequality.

2. The Method

The equation (1) shows the open static Leontief's input-output model, in which the domestic output is induced by the given final demand and export, and import is considered as the endogenous variable

$$\mathbf{X} = \left[\mathbf{I} - \left(\mathbf{I} - \hat{\mathbf{M}}\right)\mathbf{A}\right]^{-1}\left[\left(\mathbf{I} - \hat{\mathbf{M}}\right)\mathbf{F} + \mathbf{E}\right] \qquad (1)$$

where $\mathbf{X}$ is the domestic output vector, $\mathbf{I}$ is the identity matrix, $\hat{\mathbf{M}}$ is the import coefficient matrix, $\mathbf{F}$ is the domestic final demand vector and $\mathbf{E}$ is the export vector. If the domestic final demand is changed exogenously in the rate of *g*, which is the scalar value,

$$\mathbf{X}^{Fg} = \left[\mathbf{I} - \left(\mathbf{I} - \hat{\mathbf{M}}\right)\mathbf{A}\right]^{-1}\left[\left(\mathbf{I} - \hat{\mathbf{M}}\right)\mathbf{F} \cdot \left(1 + g\right) + \mathbf{E}\right] \qquad (2)$$

where the upper suffix letter "*F*" means "the exogenous change in the domestic Final demand", and "*g*" means "in the rate of *g*". Since multiplying the scalar value to the domestic final demand vector, all elements of the domestic final demand vector are changed in the rate of *g*.

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The equation (3) shows the gross value added which correspond to the inducement of domestic output,

$$V^{Fg} = \mathbf{v} \cdot \mathbf{X}^{Fg} \qquad (3)$$

where $\mathbf{v}$ is the gross value added coefficient vector. The equation (4) shows the number of workers by sector which correspond to the inducement of domestic output,

$$L_i^{Fg} = l_i \cdot X_i^{Fg} \qquad i = 1, \ldots, N \qquad (4)$$

where L_i^{Fg} is the inducement of labor in the sector "i", X_i^{Fg} is the domestic output of the sector "i" in the domestic output vector $\mathbf{X}^{Fg}$, l_i is the labor coefficient of the sector "i" and N is the number of sectors. The equation (5) shows the compensation of employees by sector which correspond to the inducement of domestic output and labor coefficient,

$$C_i^{Fg} = w_i \cdot l_i \cdot X_i^{Fg} \qquad i = 1, \ldots, N \qquad (5)$$

where C_i^{Fg} is the imputed compensation of employee in the sector "i", w_i is the compensation of employee per head. The term "imputed" means that the compensation of employee is imputed to include the compensation of non-employee workers, therefore actually it is "the compensation of workers". After putting both L_i^{Fg} and C_i^{Fg} in the ascending order of C_i^{Fg}, the Gini's coefficient, inequality measure, is calculated as equation (6).

$$G^{Fg} = 1 - \left\{ \sum_{i=2}^{N} \left(\sum_{j=1}^{i} C_j^{Fg} + \sum_{j=1}^{i-1} C_j^{Fg} \right) \left(\sum_{j=1}^{i} L_j^{Fg} - \sum_{j=1}^{i-1} L_j^{Fg} \right) + C_1^{Fg} L_1^{Fg} \right\} \Bigg/ \left(\sum_{k=1}^{N} C_k^{Fg} \cdot \sum_{k=1}^{N} L_k^{Fg} \right) \qquad (6)$$

Finally, the elasticity of nominal gross value added, which is considered as the proxy of nominal GDP, to Gini's coefficient of compensation of employee can be calculated as equation (7).

$$e^F = \frac{\Delta G^F / G^F}{\Delta V^F / V^F} = \frac{\left(G^{F1\%} - G^{F0\%} \right) / G^{F0\%}}{\left(V^{F1\%} - V^{F0\%} \right) / V^{F0\%}} \qquad (7)$$

where e^F means the "elasticity".

The influence of exogenous change in export to the gross value added and Gini's coefficient is calculated analogously, just change the upper suffix letter "*F*" of the equation (2) – (7) to "*E*", where "*E*" means "the exogenous change in the Export".

In the calculation, Japanese input output tables from 1970 to 2000, which have the largest size in number of sectors and at the same time the Leontief's inverse matrix can be calculate, were used. Numbers of intermediate sectors of those tables are about 400.

3. The Results

Table 1 shows the elasticity of change in nominal domestic final demand to Gini's coefficient of compensation of employee, and table 2 shows elasticity of change in nominal export to Gini's coefficient. Two tables have same form. In the row "A, rates of change in nominal domestic final demand are shown in two cases, 0% and 1%, as explained in the equation (7),the elasticity can be calculated by comparing these to cases. In the row "B", the nominal gross value added, which can be considered as the proxy of nominal GDP, is shown. In the row "C", Gini's coefficient of compensation of employee is shown. . IT rate of change in nominal gross value added, which is calculated from the row "B", is shown in the row "D". The rate of change in Gini's coefficient, which is calculated from the row "C", is shown. In the row "E". Finally, elasticity of nominal gross value added to Gini's coefficient of compensation of employee is shown in the row "F", which is obtained by dividing the row "E" by the row "D".

Table 1: The Elasticity of Change in Nominal Domestic Final Demand to Gini's Coefficient of Compensation of Employee

		1970		1975		1980		1985	
A	Rate of change in nominal domestic final demand (exogeneous)	0%	1%	0%	1%	0%	1%	0%	1%
B	Nominal gross value added (unit: trillion yen)	76	77	155	156	250	252	330	333
C	Gini's coefficient of compensation of employee	0.2009	0.2009	0.2163	0.2163	0.2168	0.2168	0.2095	0.2095
D	Rate of change in nominal gross value added	0.000%	0.904%	0.000%	0.897%	0.000%	0.890%	0.000%	0.877%
E	Rate of change in Gini's coefficient	0.000%	-0.006%	0.000%	0.017%	0.000%	0.020%	0.000%	0.023%
F	Elasticity(=E/D)		-0.007		0.019		0.023		0.026

		1990		1995		2000	
A	Rate of change in nominal domestic final demand (exogeneous)	0%	1%	0%	1%	0%	1%
B	Nominal gross value added (unit: trillion yen)	446	450	505	510	519	524
C	Gini's coefficient of compensation of employee	0.2078	0.2078	0.2054	0.2054	0.2329	0.2330
D	Rate of change in nominal gross value added	0%	0.905%	0%	0.917%	0%	0.904%
E	Rate of change in Gini's coefficient	0%	0.019%	0%	0.019%	0%	0.023%
F	Elasticity(=E/D)		0.021		0.020		0.025

Table 2: The Elasticity of Change in Nominal Export to Gini's Coefficient of Compensation of Employee

		1970		1975		1980		1985	
A	Rate of change in nominal export(exogeneous)	0%	1%	0%	1%	0%	1%	0%	1%
B	Nominal gross value added (unit: trillion yen)	76	76	155	155	250	250	330	331
C	Gini's coefficient of compensation of employee	0.2009	0.2009	0.2163	0.2163	0.2168	0.2167	0.2095	0.2094
D	Rate of change in nominal gross value added	0%	0.096%	0%	0.103%	0%	0.110%	0%	0.123%
E	Rate of change in Gini's coefficient	0%	0.006%	0%	-0.017%	0%	-0.020%	0%	-0.023%
F	Elasticity(=E/D)		0.062		-0.166		-0.185		-0.190

		1990		1995		2000	
A	Rate of change in nominal export(exogeneous)	0%	1%	0%	1%	0%	1%
B	Nominal gross value added (unit: trillion yen)	446	447	505	506	519	520
C	Gini's coefficient of compensation of employee	0.2078	0.2077	0.2054	0.2053	0.2329	0.2329
D	Rate of change in nominal gross value added	0%	0.095%	0%	0.083%	0%	0.096%
E	Rate of change in Gini's coefficient	0%	-0.018%	0%	-0.019%	0%	-0.023%
F	Elasticity(=E/D)		-0.193		-0.228		-0.240

4. Findings from the Results

The major findings from the result is that,

1) The observed Gini's coefficient of compensation of employee has been stable from 1970 to 1995. It means that although there was large change in the industrial structure due to the deindustrialization or "hollowing out" accompanying a strong yen after the Plaza Accord in 1985, the change in Gini's coefficient of compensation of employee was small.
2) The Gini's coefficient of compensation of employee has increased from 0.2054 in 1995 to 0.2329 in 2000. Inequality of compensation of employee between economic activities or sectors became larger in recent years. One interpretation is that this results shows dismissal or wage cut accompanied by the restructuring of Japanese economy, which became earnest in recent years.
3) The elasticity of domestic final demand is positive and that of export is negative from 1970 to 2000. it means that the growth in domestic final demand enlarge inequality and the growth in export moderate inequality. Since elasticity of domestic final demand and export have opposite signs, they offset each other.
4) The absolute value of elasticity of the change in the domestic final demand to Gini's coefficient is ten times smaller than that of export. The elasticity of export has been increasing from 1970 to 2000. . The change in export has significant effect on inequality of compensation of employee between economic activities.
5) The sign of elasticity of both domestic final demand and export in 1970 are different from those of 1975-2000. It is not clear that this change shows whether the structural change between 1970 and 1975 or not. Gini's coefficients of 1951, 1960 and 1965 are now under calculation.

Reference

Toshiaki Tachibanaki (1998), *Economic Discrepancy in Japan*, Iwanami Shinsho (in Japanese).