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Labor Share in the Change of Japanese Industrial Structure

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ABSTRACT

The investigation by E. Dietzenbacher et al. (2004) has shown the decline of the U.S. labor share for a term of 1982-1997 in spite of the rise of labor productivity. This controversial observation must be inquired to be valid for the other economy or not, and it should be explained for those dynamic causes of change. This research adopted the extended multiplicative structural decomposition analysis (SDA) by Dietzenbacher (2000 and 2004) to analyze the labor share in the change of Japanese industrial structure at 66-industry level. In this approach, the labor compensation's share in the value-added is decomposed into five parts of Fisher-type indexes as follows;

1. Changes in the real compensation per hour worked,
2. Changes in the value-added per hour worked,
3. Changes in the labor input coefficient as the structural change in technology,
4. Changes in the intermediate input coefficient,
5. Changes in the final demands.

The last two parts are known as the typical terms common to SDAs. The first two parts reflect the shift effects and the other three parts reflect the share effects. These two kinds of effects are similar to Slutsky's equation developed in analyzing the effects of price change to differentiate two parts of the income effect and the substitution effect.

This analysis adopts the database of JIDEA model version 7 constructed for the inter-industry based dynamic macroeconomic model of Japanese economy. The data in analysis was divided into two periods of time; the period of 1985-1995 and the period 1995-2005.

Decomposition approach connected with value added side

The simplest explanation of the structural decomposition approach to the economic change is shown in the following scheme. The achievement of the economic activity, is basically expressed in terms of the product of price and quantity; $Y = p \times q$.

$$\frac{Y_0 + \Delta Y}{Y_0} = \frac{Y_0 + (Y_1 - Y_0)}{Y_0} = \frac{p_0 q_0 + p_0(q_1 - q_0) + (p_1 - p_0)q_0 + (q_1 - q_0)(p_1 - p_0)}{p_0 q_0}$$

This expression is illustrated in Figure 1, using the areas of A, B, C, and D.

$$\frac{Y_0+(Y_1-Y_0)}{Y_0}=\frac{A+B+C+D}{A}.$$

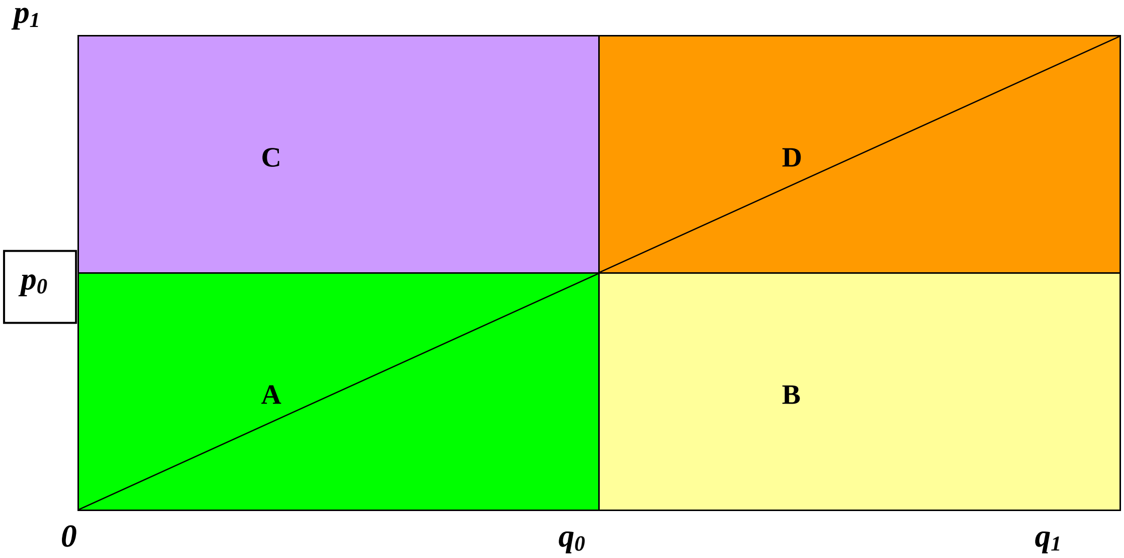


Figure 1 Content of Achievement in Economic Activity

In this analysis of decomposition of labor share, we used the data in nominal terms. Such treatment makes us possible to identify the influences caused by the price change, the quantity change and the change of both.

When we argue about the labor share in their economic activity, we have to concentrate into such a variable of labor as the activity involved in the domestic production, excluding the foreign made products. We have to separate the part of the original intermediate demand in the competing input-output table into two parts, i.e., the intermediate demand for the domestically produced goods and the intermediate demand for the imported products.

In order to make the Japanese non-competing input-output table in a framework of JIDEA model consisting of 66 industry classification, I introduced the definition of the "domestication". The domestication is defined in two ways;

$$\rho_j=\frac{\sum_i q_{ij}+V_j}{q_j}, \text{ and}$$

$$\rho_i=\frac{q_i-x_i}{q_i-x_i+m_i}.$$

The former definition was adopted in his analysis by Fujikawa (1999). The latter definition was used by Jackson (1998), Lahr (2001), and Dietzenbacher (2004). In this paper, I adopted the former definition.

The labor employed which we would like to focus on, is only involved into the part of the *intermediate demand for the domesticated products, not involved into the imported products made in foreign countries subtracted from the total output production.*

The import (imp) is assumed as a constant portion of intermediate demand plus domestic final demand. We call this constant portion as the import coefficient ($impc_i$) for each i-th industry.

$impc_i = imp_i / (totint_i + dfdtot_i)$, *or*
$impc = A^m / (Aq + f^d)$ *expressed in vector and matrix,*

where imp denotes the import, totint for the total intermediate demand, and $dfdtot_i$ (or f^d_i) for the domestic final demand in the supplying i-th industry in the notation of JIDEA model. The domestic final demand total (dfdtot) consists of the sum of cob + coh + cog + ing + ipr + ven = fd – exp – adj in JIDEA notation.

In the non-competing import type of input-output table, we can formulate the supply and demand identity of the domestic goods and the imported goods separately.

$$q = A^d q + f^d$$
$$m = A^m q + f^d$$

Defined the ratio of domestication as the formula, $\rho_j = \frac{\sum_i q_{ij} + V_j}{q_j}$, *the ratio of the import in the value-added criterion is calculated as follows;*

$$\tau^m = [1,...,1] A^m (I - A^d)^{-1} = \varsigma A^m (I - A^d)^{-1} \quad .$$

The level of import share and domestication in the industry are illustrated in the following Table 1. Prepared the import coefficient in the original competing input output table defined as the ratio of the import to the sum of the total intermediate demand and the domestic final demand, we could obtain the domesticated input output table. We use this domesticated input output table to calculate the decomposed causes in the change of labor share related to the industrial structure change and growth.

Table 1 Import Share and domestication ratio; impc=imp/(totint+dfdtot)					
		1985	1995	2005	domestication index
		exogenous	exogenous	exogenous	rho1985
1	Agri,fishe	0.1845	0.1371	0.1534	0.9309
2	Metalic or	0.9291	0.9679	0.9957	0.9640
3	Non-met or	0.1576	0.1173	0.1387	0.9747
4	Coal	0.8581	0.8880	0.9935	0.9627
5	Petro & ga	0.9993	0.9720	0.9919	0.9936
6	Food prod	0.0668	0.1370	0.1538	0.9794
7	Beverages	0.0366	0.0675	0.0541	1.0054
8	Textiles	0.1021	0.1124	0.2185	0.9825
9	Clothing	0.0896	0.2685	0.5931	1.0014
10	Wood	0.1195	0.1953	0.2965	0.9678
11	Furniture	0.0321	0.0672	0.1825	0.9806
12	Pulp&paper	0.0432	0.0519	0.0562	0.9814
13	Printing	0.0063	0.0078	0.0087	0.9855
14	Inorg chem	0.1006	0.0961	0.1879	0.9843
15	Petro chem	0.0128	0.0063	0.0153	0.9877
16	Organic ch	0.1453	0.1695	0.2740	0.9958
17	Syn resin	0.0527	0.0548	0.1590	1.0020
18	Chem fiber	0.0362	0.0527	0.1402	0.9971
19	Final chem	0.0764	0.0936	0.1413	0.9819
20	Medicine	0.0791	0.0725	0.1391	0.9923
21	Petro prod	0.1512	0.1130	0.1355	0.9785
22	Coal prod	0.0024	0.0085	0.0496	1.0031
23	Plastic pr	0.0108	0.0215	0.0666	0.9871
24	Rubber pro	0.0605	0.0999	0.1736	0.9646
25	Glass	0.0383	0.0604	0.1455	0.9742
26	Cement	0.0019	0.0021	0.0054	0.9786
27	Pottery	0.0256	0.0570	0.2155	0.9833
28	Oth cerami	0.0703	0.0711	0.1162	0.9879
29	Iron & ste	0.0186	0.0309	0.0398	0.9980
30	Nonfer met	0.4974	0.5462	0.4922	0.9827
31	Proce Nonf	0.0399	0.0494	0.1493	0.9506
32	Metal cons	0.0010	0.0066	0.0370	0.9644
33	Metal othe	0.0173	0.0298	0.0693	0.9582
34	Machine ge	0.0307	0.0477	0.0943	0.9612
35	Machine sp	0.0425	0.0653	0.1648	0.9726
36	Machine ot	0.0424	0.0434	0.0998	0.9482
37	Mach offic	0.0121	0.0569	0.1131	0.9928
38	Mach hous	0.0118	0.1015	0.2038	0.9867
39	Computer	0.1014	0.3552	0.6116	0.9749
40	Communic e	0.0190	0.1398	0.0787	0.9689
41	El apld&me	0.0914	0.1497	0.2810	0.9786
42	IC	0.1064	0.3112	0.7589	0.9882
43	Electro pa	0.0245	0.0371	0.2163	0.9864
44	Heavy elec	0.0464	0.0951	0.1934	0.9732
45	Oth light	0.0485	0.0699	0.1394	0.9795
46	Motor vehi	0.0291	0.1659	0.1184	0.9699
47	Other vehi	0.0047	0.0128	0.0290	0.9774
48	Other tran	0.1380	0.1025	0.2371	0.9619
49	Precision	0.1376	0.2314	0.3596	0.9968
50	Mfg miscel	0.1365	0.3165	0.2894	1.0001
51	Constructi	0.0000	0.0000	0.0000	0.9980
52	Civil eng	0.0000	0.0000	0.0000	0.9377
53	Civil eng	0.0000	0.0000	0.0000	0.9883
54	Elec power	0.0001	0.0000	0.0000	0.9847
55	City gas	0.0004	0.0004	0.0005	1.0234
56	Water & se	0.0001	0.0001	0.0001	0.9839
57	Trade	0.0127	0.0018	0.0082	0.9841
58	Finance	0.0069	0.0120	0.0045	0.9774
59	Transport	0.0689	0.0718	0.0985	0.9800
60	Communicat	0.0040	0.0061	0.0031	0.9557
61	Government	0.0000	0.0000	0.0000	0.9865
62	Oth public	0.0016	0.0014	0.0007	0.9695
63	Inform ser	0.0300	0.0527	0.0196	0.9772
64	Buisnes se	0.0167	0.0249	0.0188	0.9780
65	Persnl Ser	0.0228	0.0728	0.0507	1.0053
66	Office sup	0.0514	0.0741	0.0568	0.9744
					0.9803

The equations and the variables for the industry i in this analysis are all similar to the Dietzenbacher, et. al. (2004);

v_i = *value added*
w_i = *labor compensation*
l_i =*labor input in terms of hour worked*
$\pi_i = v_i / l_i$ = *labor productivity*
$\alpha_i = w_i / l_i$ = *wage per labor worked*
$\lambda_i = l_i / x_i$ = *labor worked per total output*
$\sigma_i = w_i / v_i$ = *labor share; wage in value added*

where $v = \sum_i v_i, w = \sum_i w_i$, *and* $l = \sum_i l_i$.

$\pi = v/l$, $\alpha = w/l$, *and* $\sigma = w/v$ *will be calculated as an aggregated values.*

$\alpha = \dfrac{\alpha' \hat{\lambda} Lf}{e' \hat{\lambda} Lf}$, *where e' = (1, . . . , 1). The labor productivity as a whole economy is expressed as follows;*

$$\pi = \frac{v}{l} = \frac{\pi' \hat{\lambda} x}{\lambda' x} = \pi' s = \frac{\pi' \hat{\lambda} Lf}{e' \hat{\lambda} Lf}.$$

$$\sigma = \frac{w}{v} = \frac{\alpha' \hat{\lambda} Lf}{\pi' \hat{\lambda} Lf}.$$

The final task in this research is to decompose the labor share in the value added into the possible causes.

$$\sigma = \frac{w}{v} = \frac{w/l}{v/l} = \frac{\alpha}{\pi},$$

where α *shows the wage per total income;* $\alpha = \dfrac{w}{l} = \dfrac{\alpha' \hat{\lambda} x}{\lambda' x} = \alpha' s$.

^ *denotes the diagonal matrix.* $x = (I - A)^{-1} f \equiv Lf$, *where A=$A^d$ implies the input coefficient excluding import, and* $L = (I - A)^{-1}$ *shows Leontief Inverse.*

We can calculate the labor share of the input-output based output in the following equations in the decomposition approach as described by Dietzenbacher, et. al.

$$\frac{\sigma_1}{\sigma_0} = \left(\frac{\alpha'_1 \hat{\lambda}_1 L_1 f_1}{\alpha'_0 \hat{\lambda}_1 L_1 f_1} \right) \left(\frac{\pi'_0 \hat{\lambda}_1 L_1 f_1}{\pi'_1 \hat{\lambda}_1 L_1 f_1} \right) \left(\frac{\alpha'_0 \hat{\lambda}_1 L_1 f_1}{\alpha'_0 \hat{\lambda}_0 L_1 f_1} \frac{\pi'_0 \hat{\lambda}_0 L_1 f_1}{\pi'_0 \hat{\lambda}_1 L_1 f_1} \right)$$

$$\times \left(\frac{\alpha'_0 \hat{\lambda}_0 L_1 f_1}{\alpha'_0 \hat{\lambda}_0 L_0 f_1} \frac{\pi'_0 \hat{\lambda}_0 L_0 f_1}{\pi'_0 \hat{\lambda}_1 L_1 f_1} \right) \left(\frac{\alpha'_0 \hat{\lambda}_0 L_0 f_1}{\alpha'_0 \hat{\lambda}_0 L_0 f_0} \frac{\pi'_0 \hat{\lambda}_0 L_0 f_0}{\pi'_0 \hat{\lambda}_0 L_0 f_1} \right),$$

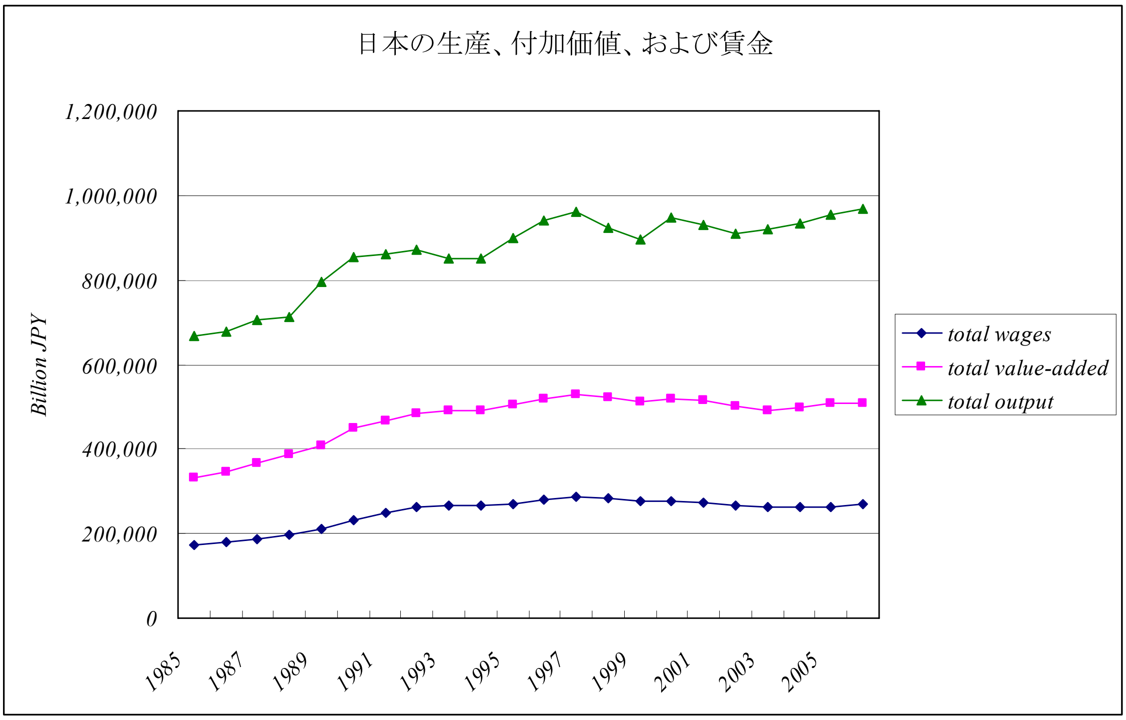
and

$$\frac{\sigma_1}{\sigma_0} = \left(\frac{\alpha'_1 \hat{\lambda}_0 L_0 f_0}{\alpha'_0 \hat{\lambda}_0 L_0 f_0} \right) \left(\frac{\pi'_0 \hat{\lambda}_0 L_0 f_0}{\pi'_1 \hat{\lambda}_0 L_0 f_0} \right) \left(\frac{\alpha'_1 \hat{\lambda}_1 L_0 f_0}{\alpha'_1 \hat{\lambda}_0 L_0 f_0} \frac{\pi'_1 \hat{\lambda}_0 L_0 f_0}{\pi'_1 \hat{\lambda}_1 L_0 f_0} \right)$$

$$\times \left(\frac{\alpha'_0 \hat{\lambda}_1 L_1 f_0}{\alpha'_1 \hat{\lambda}_1 L_0 f_0} \frac{\pi'_1 \hat{\lambda}_1 L_0 f_0}{\pi'_1 \hat{\lambda}_1 L_1 f_0} \right) \left(\frac{\alpha'_1 \hat{\lambda}_1 L_1 f_1}{\alpha'_1 \hat{\lambda}_1 L_1 f_0} \frac{\pi'_1 \hat{\lambda}_1 L_1 f_0}{\pi'_1 \hat{\lambda}_1 L_1 f_1} \right).$$

In the following Figure 2, 3, and 4, we prepared the historical figures of the related variables in Japan. However, the decomposition approach illustrates the structure at the specific point of time.

Figure 2 Output, Value-added and Wage in Japan



The change in labor share as a whole economy does not correspond to the fluctuation in the output as a whole economy. It is necessary to inter-exchange the sets of variables which are measured at time(0) and time(1). The results of the complete compilation will be given shortly.

Figure 3 Japanese labor share

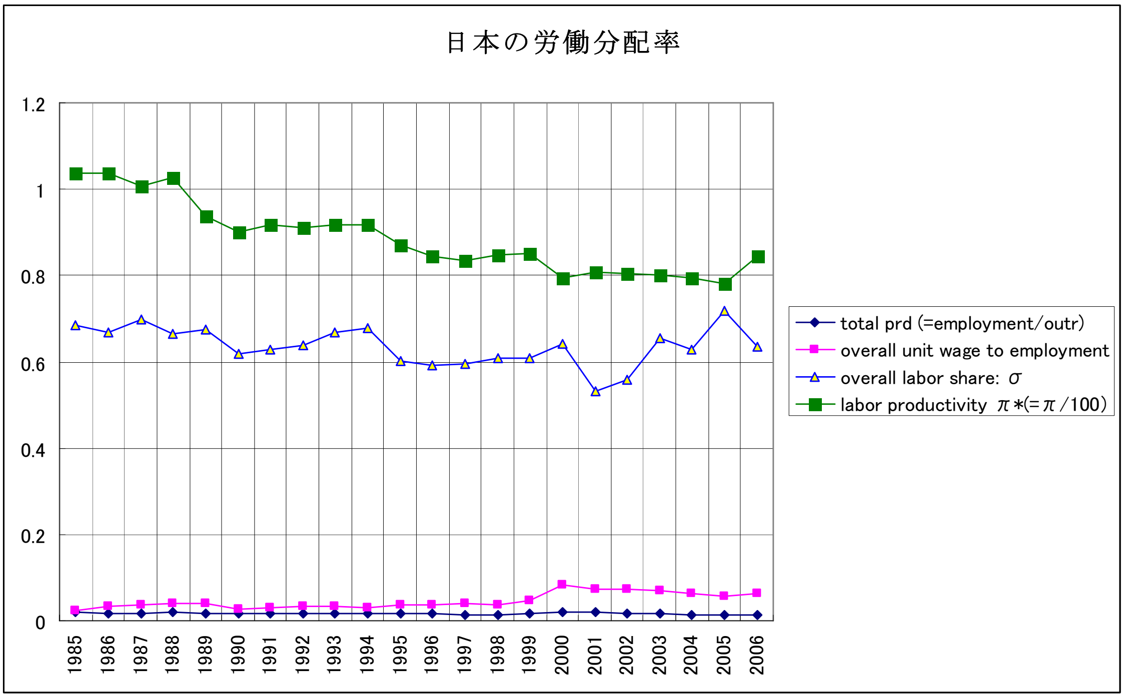
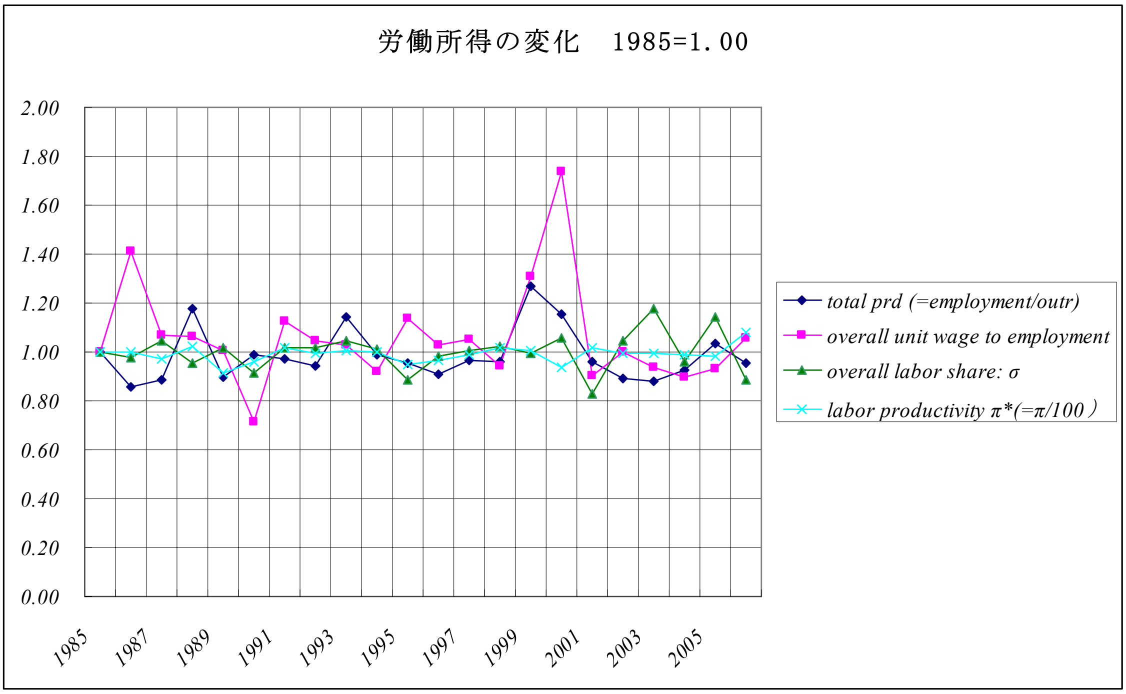


Figure 4 Change in Labor Compensation



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