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Causes of decline in labor's share in Japan

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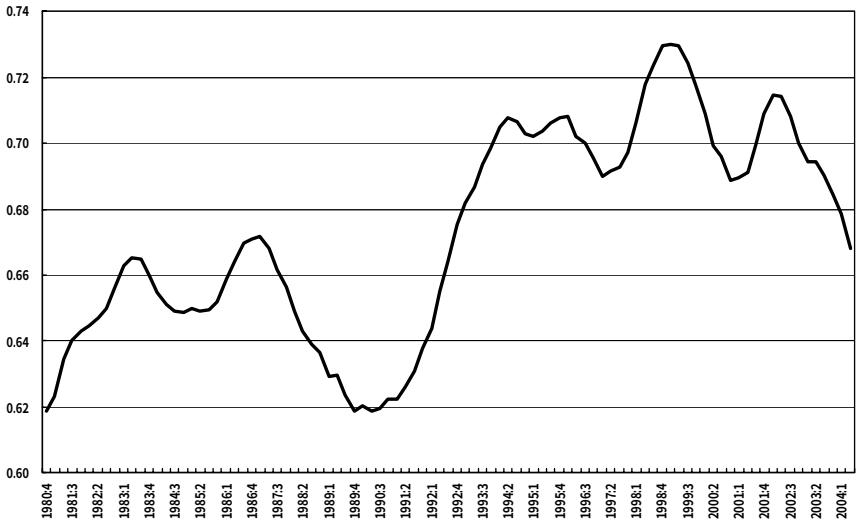
The ratio of total value added attributable to labor, or labor's share, has been declining in Japan in recent years. (See Exhibit 1.) Kaldor postulated as one of his "stylized facts" that the share was stable overtime in many countries around the world. The ratio, however, has exhibited significant fluctuations in Japan and has been used as an important benchmark that helps account for various macroeconomic activities, as well as firm's profitability at a microeconomic level. A feeble recovery in consumption spending may well be caused by sustained decline in the labor's share, while a stronger improvement in corporate profits and private investments may have been a result of increase in capital's share, which equals unity less labor's share. Microeconomically, return on total assets (ROA), which measures the operating efficiency of a firm, is of great relevance, since ROA, defined as operating profit divided by fixed assets, can be reexpressed as the product of productivity of capital and capital's share.

Exhibit 1 Labor's share (defined as personnel cost/ (personnel cost + operating profit + depreciation))



Note: quarterly moving average data of the trailing four quarters.
Source: Financial Statements Statistics of Corporations by Industry, Quarterly

What changes will likely happen in Japan in coming years to labor's share, which can thus exercise a significant influence on the performance of the economy? In order to gain insight into the question, first, we need to understand the backdrop against which labor's share showed a distinctive behavior in the early 1990s. More specifically, labor's share dramatically rose in the early 1990s but has been on a downward trend since 2002. By exploring the details of the former phenomenon, we seek to explain the mechanism by which labor's share has been declining since 2002 and project its future trend.

Labor's share can be rearranged as (unit labor cost/prices), or (real wage/labor productivity) and changes in the share can be explained by changes in the denominator and numerator of respective expressions. Such explanation, however, is mere factor decomposition based on the definition of the term.

In the rest of this paper, a theoretical explanation to changes in labor's share is attempted assuming a production function with constant elasticity of substitution (CES production function), where changes in factor shares can be explicitly expressed. By employing the statistical methods of the unit root test and co-integration test with consideration to potential structural changes, we test a hypothesis that there was a structural change in which labor's share was affected as a result of a shift in elasticity of substitution between capital and labor (changes in the factor input ratio in response to changes in the relative price of the two production factors).

A CES production function is expressed as:

$$Y_t = \left[\alpha (A_L L_t)^{\left(\frac{\sigma-1}{\sigma}\right)} + (1-\alpha)(A_K K_t)^{\left(\frac{\sigma-1}{\sigma}\right)} \right]^{\left(\frac{\sigma}{\sigma-1}\right)} \qquad \cdots\cdots (1)$$

Assuming profit maximization by firms where marginal productivity of labor equals real wage, the above function can be rearranged to yield labor's share at the equilibrium as:

$$\frac{W_t L_t}{P_t Y_t} = \alpha \left(\frac{Y_t}{A_L L_t} \right)^{\frac{1-\sigma}{\sigma}} \qquad \cdots\cdots (2)$$

where the symbols are defined as W: nominal wage, L: number of employees, P: prices, Y: real factor income, AL total factor productivity (TFP), σ: elasticity of substitution between capital and labor ($\sigma \neq 1$) and α: a parameter to ensure constant return to scale as $\sigma \to 1$ ($0 < \alpha < 1$). In actual estimation, we rearrange the expression (2) into (3) by taking logarithm of both sides and conduct an estimation of values that give a long-term equilibrium between real wage and labor productivity. Please note that θ, the coefficient on labor productivity, is the inverse of elasticity of substitution.

$$\ln\left(\frac{W_t}{P_t}\right) = \frac{1}{\sigma}\ln\left(\frac{Y_t}{L_t}\right) + \left[\ln(\alpha) - \left(\frac{1-\sigma}{\sigma}\right)\ln(A) \right] = \theta \ln\left(\frac{Y_t}{L_t}\right) + \lambda \qquad \cdots\cdots (3)$$

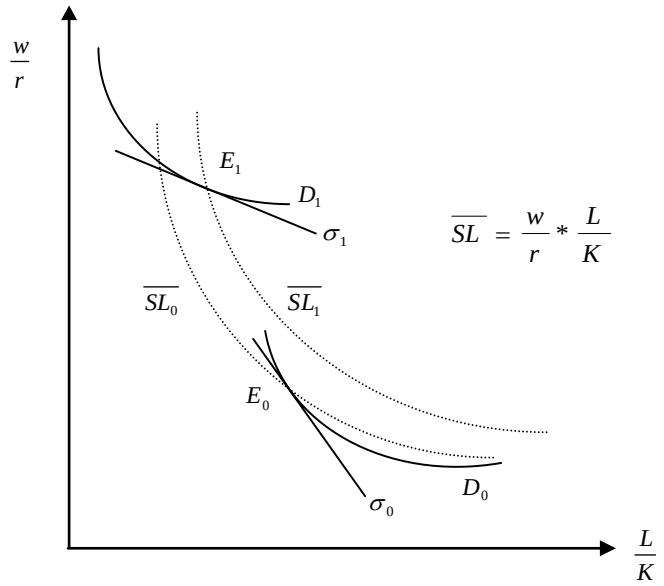
Our interest here is whether, after 1980, especially in the early 1990s, there was a structural change in the long-term relationship represented by the equation (3), or alternately, labor's share was on an upward trend in response to increase in labor productivity under the condition that elasticity of substitution is below one, with no particular changes in the long-term structure.

In analyzing the issue above, data stationarity holds an important key. Labor's share, as has already been discussed, significantly increased in the early 1990s. This may possibly indicate that, rather than the data being non-stationary, there occurred a structural change. In this report, we carried out a unit root test as per Perron (1997) and a co-integration test as per Gregory=Hansen (1996), both with consideration to potential structural changes.

First, a unit root test as per Perron of real wage and labor productivity data gave no indications of a structural change, concluding that "the time series data was non-stationary" as the null hypothesis. The test results implied the two time series data could be considered variables of I(1), whose first differences are stationary. The co-integration test as per Gregory=Hansen, however, rejected the null hypothesis that "there was no co-integration relationship between the two variables" at a significance level of 10%, with the estimated timing of the structural change in the third quarter of 1992.

By running separate regressions of the equation (3) for periods before and after the third quarter of 1992, at which point a structural change was estimated to have happened, estimated elasticity of substitution was higher at 1.681 after change, compared with 1.286 before change. Also taking into account that the growth in TFP dramatically slowed in the early 1990s, the results can be interpreted as indicating that there was a level shift in labor's share as a consequence of a large relative outperformance of real wage, which was, in turn, caused by an increase in constant λ in (3), due to rise in elasticity of substitution as mentioned above. (See Exhibit 2.)

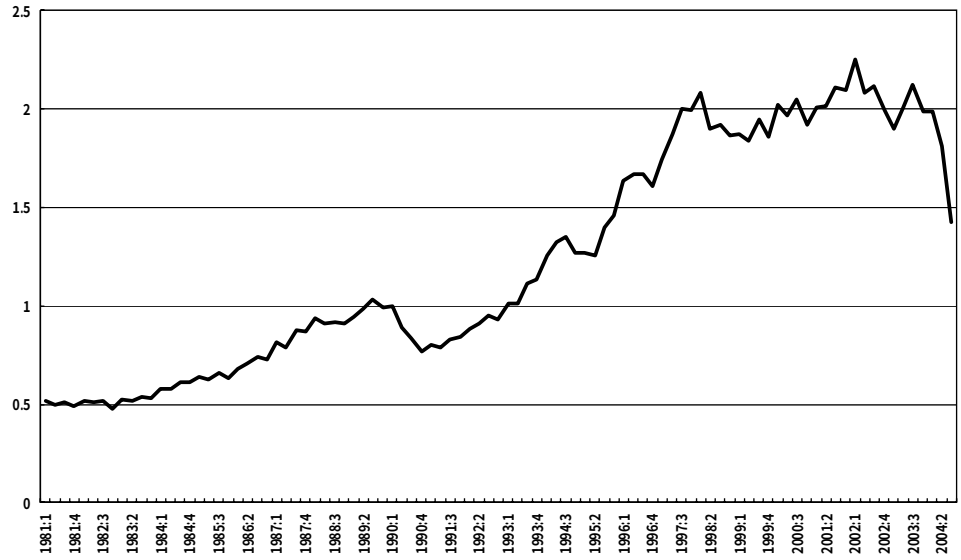
Exhibit 2 Change in elasticity of substitution（σ） and change in the ratio of labor income to total profit (SL)



Note: Each of curves D represents a production factor demand curve, where the slope of the straight line tangent to it represents elasticity of substitution. The steepness of the line is inversely related to the size of elasticity, *i.e.* $\sigma_0 < \sigma_1$. Dotted curves represent loci on which w/r and L/K are so combined that the ratio of labor income to total profit remain constant at $\overline{SL}$. Note that $\overline{SL_0} < \overline{SL_1}$. As an economy shifts from E_0 to E_1, elasticity of substitution becomes greater and so does SL, resulting in higher labor's share.

Then, what brought about such change in elasticity of substitution? Have there been any changes to those causes in recent years when labor's share has been declining? The first to note is the changes in the relative price of labor to capital. After calculating a direct proxy for cost of capital from various data, trends in the relative factor price, or the ratio of real wage to real cost of capital, is observed. This reveals a significant pickup in the rate of increase in the ratio at about 1990, which implies a possible change in the trend. (See Exhibit 3.) It appears that firms made a transition to a structure that enabled more elastic management of the capital-labor ratio.

Exhibit 3　Relative factor price
(real wage/real cost of capital, 1Q1990＝１)



Note: Real cost of capital (C) has been calculated as below.

$$C = \frac{Pi}{P}\left[\{r(1-u)-\pi\} * b + \{PER + eg - \pi\} * (1-b) + d\right] * \frac{(1-u*z)}{1-u}$$

where

Pi: deflator for private sector capital expenditures, P: GDP deflator, r: prime rate for long-term loans, u: effective corporate tax rate (direct taxes on private corporate income/private corporate income, SNA-based), π: rate of change in GDP deflator, b: net liabilities/(net liabilities + capital stock), net liabilities = liabilities – allowances classified as fixed liabilities – cash and deposits – accounts receivable – (securities – equities classified as current assets), PER: Earnings yield/(1 - cross-shareholding ratio), eg: expected growth rate over the next three years, d: rate of capital retirement and z: rate of depreciation/(rate of depreciation + real total cost of capital), where real total cost of capital = {r(１－u)－π}b+(PER+eg－π)(1－b).

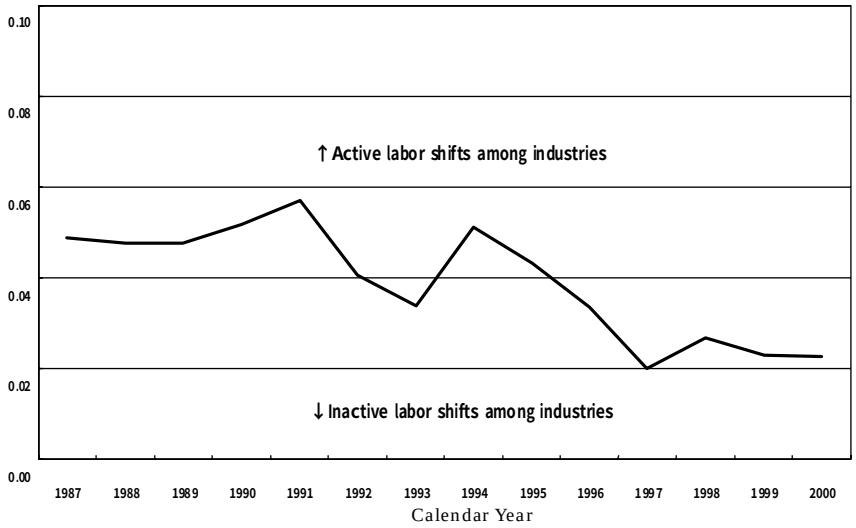
Real wage is calculated as total cash compensation paid as wage and salaries/total hours worked/GDP deflator.

Source: Financial Statements Statistics of Corporations by Industry, Quarterly, System of National Accounts (SNA), Private Sector Capital Stock Statistics and Monthly Labor Survey.

The second possible cause is decrease mobility in the labor market. As was pointed out in JCER (2004), Lilien measure of labor mobility experienced a major decline in 1992, the same year in which a structural change took place according to the results from the aforementioned test. Given this, it is inferred that firms began to manage the capital-labor ratio more elastically because labor had become a more difficult production factor to adjust.

Diminished capabilities of firms in adjusting wage and employment in the early 1990s are considered attributable, for the most part, to: i) tight labor market conditions towards the end of the bubble economy had a prolonged effect, ii) there was a strong fear of future labor shortage due possibly to work hour reduction and aging population and iii) in the early 1990s in the aftermath of the bubble, firms expected the economic growth rate to be higher than it actually turned out.

Exhibit 4　Lilien measure（Index of mobility in the labor market）



Source: JCER (2004), "Industry Research Report 2003: The Industrial Structure and the Revitalization of the Japanese Economy" and data from JIP database published by the Cabinet Office.
Note: Lilien measure is an indexed measure of labor shifts among industries and is derived from the following formula:

$$Lilien\ Measure = \left[\sum_{i=1}^{n} S_{Li} \left(\frac{\Delta L_i}{L} - \frac{\Delta L_A}{L_A} \right)^2 \right]^{1/2}$$

L_i: employment in industry i, L_A: total employment, S_{Li}: employment share of industry i

The relative factor price has been on a downward trend since about 2002 in tandem with the decline in labor's share in recent years. As real wage growth has been in check and, more recently, antiquated capital has been retired in an accelerated fashion, cost of capital relative to labor has been increasing. Labor market mobility has also started to show signs of improvement. Due to data limitations, Lilien measure in more recent years of sectorial shifts among eighty-four industry classifications cannot be calculated. However, proxy figures based on the annual data on twenty-one industries from the System of National Accounts, encompassing from private manufacturing and non-manufacturing industries excluding agriculture, fisheries and mining to non-profit services, were observed to show a move similar to that of Lilien measure on eighty-four industry classifications when such data was available, and the proxy measure thereafter was seen to rise over the period from 2000 to 2002, reversing the downward trend up to that time.

The latter finding is still preliminary and more rigorous statistical tests need to be performed to verify the occurrence of a structural change. There is, however, a strong likelihood that improved capabilities to adjust both wage and employment have lowered elasticity of substitution between production factors by firms, leading to a recent decline

in labor's share.

The downward trend in labor's share may persist in the foreseeable future in association with improvements in ROA of Japanese companies, which face fierce international competition. As was previously mentioned, ROA, defined as operating profit divided by fixed assets, can be rewritten as the product of productivity of capital and capital's share of income. An increase in ROA, therefore, is accompanied by a rise in capital's share. According to Kameda and Takagawa (2003), levels of ROA are still low at Japanese companies in an international comparison. In order to boost capital's share in Japan and, consequently, ROA levels of companies there, labor market flexibility in adjusting wage and employment needs to be further enhanced.

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