|||||||| 研究ノート ||||||||

A Simple Model for a Japanese Firm as a Quasi-Labor-Managed Firm

Tamotsu Nakamura

I. Introduction

Recently some influencial economists, for example Abegglen and Stalk(1985) and Komiya(1989), insist that the Japanese firms are like labor-managed firms. An important objection to this assertion is that it cannot explain that the Japanese firms grow fast. This objection is based on the famous result in Atkinson(1973), which shows that labor-managed firms grow more slowly than capitalistic firms.[1]

The above-mentioned assertion does not insist that the Japanese firms are pure labor-managed firms but only points out that structural and behavioristic characteristics of the Japanese firms are like those of labor-managed firms. In fact, Komiya argues that the Japanese firm *"chooses the amount of output and the amounts of labor and capital inputs so as to maximize income per employee……after the payment of a fixed share of profits to stockholders"* (p.115).

In this paper, following Komiya, we assume that the Japanese firm behaves as the labor-managed firm with the profit-sharing between enployees and stockholders and analyze it.[2] We could call this firm the quasi-labor-managed firm in the sense that it is not the pure labor -managed firm. The main difference between the model discussed in this paper and Komiya's claim is that while in Komiya's claim decisions on both labor and capital inputs are made by workers alone, in our model the long-run programs (*i.e.* investment desicions) are designed by not workers but stockholders and only the short-run decisions on output and labor input by workers. In Japan, as Sheard (1989) and Aoki (1990) point out, banks and other financial insititutions as stockholders influence corporate decisions at least in the long-run in order to pursue their own interests. The above hypothesis reflects this fact.

The organization of this note is as follows. Nect section presents main hypotheses and following them Section III sets up the model. Section IV derives the main propositions and the Section V analyzes then properties of the optimal time path. Final section provides some concluding remarks.

II. The Basic Hypotheses

There are two decision-makers in the firm analyzed in this paper: workers and stockholders. It is assumed that all workers are homogeneous and all stockholders have uniform preferences.

We will present the importane hypotheses which are maintained throughout this note in tern.

Hypothesis 1:*Profits, which are defined as revenue minus costs for replacement of capital, are shared between workers and stockholders at a constant ratio.*

This expresses the profit-sharing manner.

Hypothesis 2:*In the short-run, workers choose the amounts of output* *and labor input so as to maximize income per worker under given capital stock and the profit-sharing coefficient.*

This hypothesis implies that stockholders leave their business in the charge of their employees. If they run the firm directly or through employed manegers, they must bear monitoring or agency costs in addition to wage-payments. Leaving the firm to workers may therefore reduce administrative costs, and give workers incentives to work in earnest because their incomes directly depends on their efforts.

Hypothesis 3:*The long-run program (on capital accumulation) is designed by stockholders so as to maximize the discounted present value of net cash flow which they recieve.*

This hypothesis ensures that stockholders are ultimate owners of the firm. Obviously, from the above hypotheses, stockholders play the role of lenders of real capital.

To simpily the analysis, we add the following hypotheses.

Hypothesis 4:*Work hours are institutionally fixed;it is asummed to be unity, therefore the number of workers employed is equal to labor input.*

Hypothesis 5:*The firm sell its products in a competitive market, and there is no uncertainties in the world.*

III. The Model

Suppose that the firm produces output Y out of labor N and capital K by the production function $F(N, K)$. This function is assumed to be homogeneous of degree one: $F(N, K)=f(n)K$ where $n \equiv N/K$ is the labor-capital ratio., and to have the following properties: $f'>0$, $f''<0$, $f'(0)=\infty$ and $f'(\infty)=0$. Let I be the rate of real gross investment and assume that the adjustment cost of investment including purchase cost is a function of the rate of gross investment and capital stock, $qC(I, K)$, with $C(I,K)=c(g)K$, $c(0)=0$, $c'(0)=1$, $c'(g)>0$ $c''(g)>0$ *for* $g>0$, where q is the price of investment goods and $g \equiv I/K$ is the (gross) investment-capital ratio.[3]

Assuming that the physical depreciation of capital is proportional to the capital stock, the capital accumulation equation is:

$$\dot{K}(t) = (g(t) - \delta)K(t) \qquad K(0) = K_0\text{:given}, \qquad (1)$$

where δ is the rate of depreciation and dot denotes the time-derivative.

From the above assumptions, the cost for the replacement and the cost for the net investment are expressed as $q(t)c(\delta)K(t)$ and $q(t)\{c(g(t)) - c(\delta)\}K(t)$ respectively. Let p be the output price. As instantaneous profits at time t are $[p(t)f(n(t)) - \{q(t)c(\delta)\}]K(t)$, the problem for workers is formulated as follows:

$$\text{(W)} \quad \underset{n(t)}{\text{Max}} \quad \frac{\lambda(t)\ \{p(t)f(n(t)) - q(t)c(\delta)\}}{n(t)}$$

where $\lambda(t)$ is the profit-sharing coeffient with $0<\lambda(t)<1$.

The program for stockholders to design is:

$$\text{(S)} \quad \underset{g}{\text{Max}} \quad \int_0^\infty R(t)\ [(1-\lambda)\ \{pf(n^*) - qc(\delta)\} - q\ \{c(g) - c(\delta)\}]\ Kdt,$$

subject to (1) and

$$n^* \equiv \underset{n}{\arg\max} \ \frac{\lambda\ \{pf(n) - qc(\delta)\}}{n}$$

where

$$R(t) \equiv \exp\ \{-\int_0^t \rho(v)dv\}$$

and ρ(v) is the instantaneous discount rate.
(Time arguments are suppressed when no ambiguity results.)

IV. The Main Propositions

We obtain the folloing lemmas from the first order condition for the problem (W) as below:

$$p\ \{f(n^*)-n^*f'(n^*)\}=qc(\delta). \tag{2}$$

Lemma 1: The optimal labor-capital ratio(n) does not depend on the coeffient λ, and therefore in the shot-run the number of workers employed(n*K) is independent of λ.*

Lemma 2: In the short-run Word's Theorem, so-called "perverse" behavior, holds as follows:[4]

$$\frac{dn^*}{dp}=\frac{f(n^*)-n^*f'(n^*)}{pn^*f''(n^*)}<0, \tag{3}$$

$$\frac{dn^*}{dq}=-\frac{c(\delta)}{pn^*f''(n^*)}=-\frac{f(n^*)-n^*f'(n^*)}{qn^*f''(n^*)}>0. \tag{4}$$

Lemma 3: When prices of output and investment goods are invariant over time, then the optimal labor-capital ratio (n) is also time-invariant.*

For simplicity, we limit our analysis to the case of static expectations on prices of output and investment goods (p and q) and the instantaneous discount rate (ρ).

Proposition 1: If a solution for the problem (S) exists, then it is unique *and the optimal g, g*, is invariant through time and determined by the equation as hellows:*

$$\frac{(1-\lambda)pf(n^*)+\lambda qc(\delta)-qc(g^*)}{\rho+\delta-g^*}=qc'(g^*). \tag{5}$$

Proof: Let $\pi\equiv(1-\lambda)\text{pf}(\text{n}^*)+\lambda\text{qc}(\delta)$. The problem (S) is refomulated as:

$$\underset{g}{\text{Max}}\int_0^\infty \exp(-\rho t)\ \{\pi-\text{qc}(\text{g})\}\ \text{Kdt},$$

subject to (1),

where π is constant over time from assumptions and Lemma 3.
The above problem is analyzed in Uzawa (1969). Uzawa shows that if a solution exists, then it is unique and time-invarinat and that the optimal condition is $\{\pi-\text{qc}(\text{g}^*)\}/(\rho+\delta-\text{g}^*)=\text{qc}'(\text{g}^*)$.[5] Q.E.D.

Also, (5) shows that when $(1-\lambda)\text{pf}(\text{n}^*)+\lambda\text{qc}(\delta)$ is larger than $(\rho+\delta)$q, then g* is positive, and vice versa. Our analysis focuses on the case that $(1-\lambda)\text{pf}(\text{n}^*)+\lambda\text{qc}(\delta)$ is larger than $(\rho+\delta)\text{q}$, because other cases are trivial.

From (5) and Lemmas, we get:

$$\frac{\text{dg}^*}{\text{dp}}=\frac{(1-\lambda)\text{f}(\text{n}^*)(1-\sigma)}{(\rho+\delta-\text{g}^*)\text{qc}''(\text{g}^*)}\gtreqless 0 \iff \sigma\lesseqgtr 1, \tag{6}$$

$$\frac{\text{dg}^*}{\text{dq}}=\frac{(1-\lambda)\text{pf}(\text{n}^*)(\sigma-1)}{(\rho+\delta-\text{g}^*)\text{q2c}''(\text{g}^*)}\gtreqless 0 \iff \sigma\gtreqless 1, \tag{7}$$

$$\frac{\text{dg}^*}{\text{d}\rho}=-\frac{\text{c}'(\text{g}^*)}{(\rho+\delta-\text{g}^*)\text{c}''(\text{g}^*)}<0, \tag{8}$$

$$\frac{dg^*}{d\lambda} = -\frac{pf(n^*) - qc(\delta)}{(\rho + \delta - g^*)qc''(g^*)} < 0, \qquad (9)$$

where $\sigma \equiv -f'(f - n^*f')/n^*ff''$ is the elasticity of substitution.

In the case of capitalistic firms it is obvious that dg^*/dp is positive and dg^*/dq is negative. As for the firm analyzed here, on the contrary, dg^*/dp is negative and dg^*/dq is positive when $\sigma > 1$. We could call these characteristics the dynamic "perverse" behavior.
Therefore we can state the following proposition.

Proposition 2 (Dynamic Word's Theorem): When the elasticity of substitution is larger than unity, there is the dynamic "perverse" behavior on both the price of output and the investment goods price.

At a glance, Proposition 2 seems to suggest the price mechanism does not work in the dynamic context as well as in the static context. But, this interpretation might be erroneous because the effects of the profit -sharing coeffient λ and the discount rate ρ on the gross capital accumulation rate g^* are the same as those in the case of capitalistic firms. In our model the nominal wage rate is $\lambda\{pf(n^*) - qc(\delta)\}$. If the coefficient λ changes so as to adjust the disequilibrium in the labor market, in other words, if λ rises when the unemployment rate is low, and vice versa, then the price mechanism works at least in the long-run through λ as the proxy of the nominal wage rate.

V. On the Optimal Time Path

In this section, using properties which are derived in the previous section, we investigate properties of the dynamic path of the output level. To simply the anlysis, we assume that the unanticipated fall in output price occurs once and for all at time T_0.

Figure-1 shows the time path of the output level (in logarithm) in the case that the elasticity of substitution (σ) is larger than unity, where a dash line indicates the time path in the case that the output price dose not change.

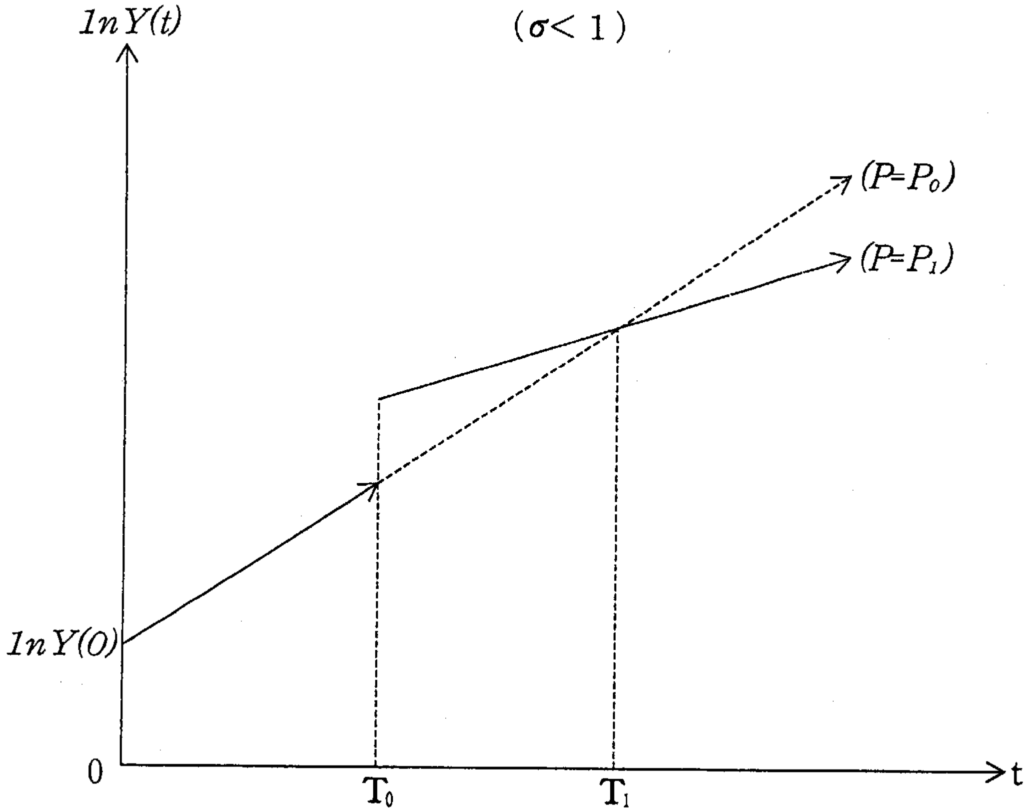

Figure- 1

In spite that the output price declines, in the period form T_0 to T_1, the output is larger than that in the case that the price is time-invariant.

Assuming that the firm is an exporting firm, we could interpret p as Ep^*, where E is the (domestic currency)/(foreign currency) exchange rate and p^* is the exporting price in foreign currency. An appreciation of the domestic currency (a fall in E) implies a fall in p. A fall in E

reduces output in the long-run. In the short-run, however, it rather increases the output level. This indicates the possibility that the behavior of the firm amplifies the so-called 'J-curve effect'.

The cases that $\sigma=1$ and $\sigma<1$ are shown in Figure-1 and Figure-2, respectively.

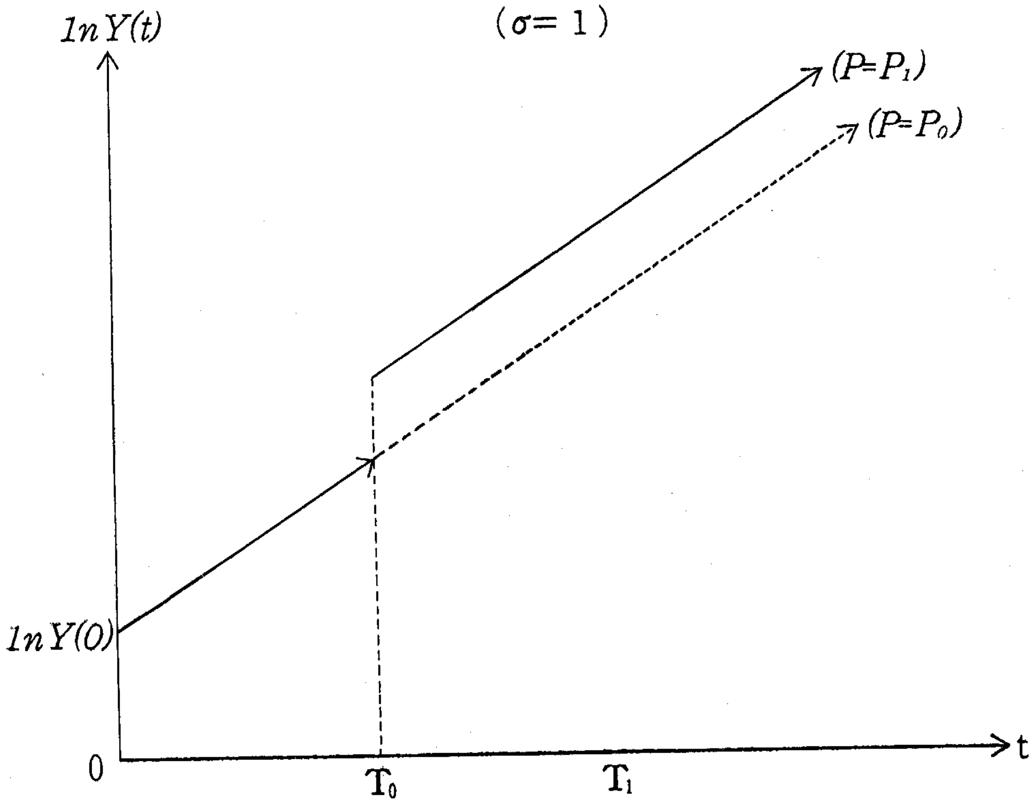

Figure- 2

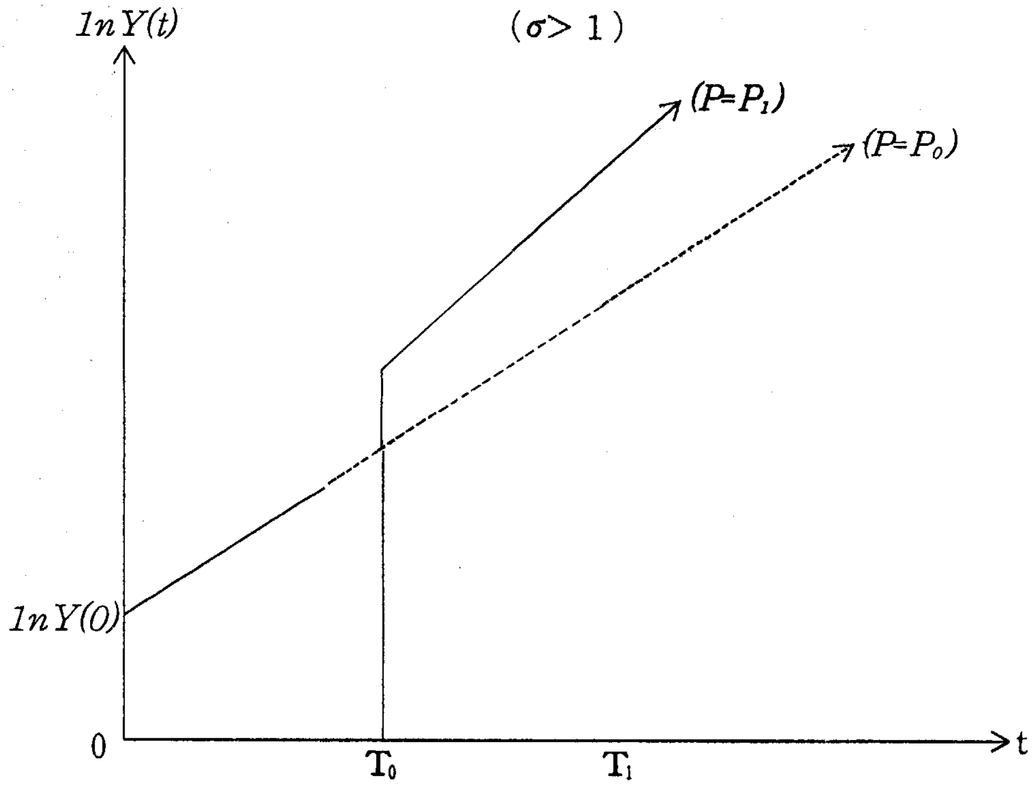

Figure- 3

Fung (1992) analyzes the Aoki-type cooperative exporting firm and set forth that it raises its growth rate in the face of unfavorable change in exchange rate. Our analysis, on the contrary, shows that the responce of the firm analyzed in this paper to the change in exchange rate depends on its production structure.

VI. Concluding Remarks

In this paper, we set up a simple model for the Japanese firm following the claim that the Japanese firms are like labor-managed firms. The firm analyzed here has properties which are different from capitalistic firms. Its behavior is *"perverse"* not only in the static context but also in the dynamic context. Nevertheless, with regard to the fact that the important determinant of firm growth is the profit share there is no difference between the firm analyzed in this paper and capitalistic firms. It is often cited that the labor share in Japan is much lower than those in other industrial countries and it creats the fast growth and strong competitiveness of the Japanese firms. Our tentative analysis does not contradict this assertion.

So far we assume that the sharing coefficient is exogenous. But it may be determined by reflecting the relative bargaing power between workers and stockholders and the labor market conditions. This is the remaining problem to be solved.

FOOTNOTES

1. See Aoki (1990) and Yoshikawa (1991).
2. For profit-sharing, see, for example, Wadhwani (1987).
3. This adjustment cost function is often called Uzawa-Penrose type. See Uzawa (1969), Hayashi (1982) and Yoshikawa (1980).
4. For Word's Theorem ("perverse" behavior), see Word (1958), Vanek (1970) and Mead (1972).
5. Hayashi (1982) and Yoshikawa (1980) also analze the same problem and confirm Uzawa's result.

REFERENCES

1) Abegglen, James C, and Stalk, George, Jr., *Kaisha, the Japanese Corporation.* NY: Basic Books, 1985.
2) Aoki, Masahiko, "Toward an Economic Model of the Japanese Firm." *J. Econ. Lit. 28* : 1-27, Mar. 1990.

3) Atkinson, Anthony B., "Worker Management and the Modern Industrial Enterprise." *Quart. J. Econ., 87,3* : 375-392, Aug. 1973.
4) Fung, K. C., "Some International Properties of Japanese Firms." *J. of Jap. and Int. Econ. 6* : 163-175, 1992.
5) Hayashi, Fumio, "Tobin's Marginal q and average q:a Neoclassical Interpretation." *Econometrica 50*, 1 : 213-24, Jun. 1982.
6) Komiya, Ryutaro, "Structural and Behavioral Characteristics of the Japanese Firm." in Japanese in *Geandai Chugoku Keizai: Nichuu no Hikaku Kosatsu (The Contemporary Chinese Economy: A Comparative Study of Japan and China),* pp.97-145. Tokyo: Univ. of Tokyo Press, 1989.
7) Meade, James E., "The Theory of Labour-Managed Firms and of Profit Sharing." *Econ. J. 82*, 325s: 402-428, Mar. 1972.
8) Shead, Paul, "The Main Bank System and Corporate Monitoring and Contorol in Japan." *J. Econ. Behav. Organ. 11, 3* : 399-422, May. 1989.
9) Uzawa, Hirofumi, "The Time Preference and the Penrose Effect in a Two-Class Model of Economic Growth." *J. Polit. Econ., 77, 2* : 628-52, July/Aug. 1969
10) Vanek, Jaroslav, *The General Theory of Labor-Managed Market Economies,* Ithaca, NY/London: Cornell Univ. Press, 1970.
11) Wadhwani, Sushil B., "Profit-Sharing and Meade's Discriminating Labour-Capital Partnerships: A Review Article." *Oxford Econ. Pap., 39* : 421-442, 1987.
12) Ward, Benjamin, "The Firm in Illyria: Market Syndicalism." *Amer. Econ. Rev. 48, 4* : 566-589, Sept. 1958.
13) Yoshikawa, Hiroshi, "On the "q" Theory of Investment." *Amer. Econ. Rev. 70, 4* : 738-43, Sept. 1980.
14) ————, "Investment Behavior of Japanese Firms." in Japanese In Hirofumi Uzawa ed. *Nihonkigyo no Dynamism (Dynamism of Japanese Firms),* pp.47-73. Tokyo: Univ. of Tokyo Press, 1991.