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Optimal Properties of Wage and Layoff Policies and the Impact of Trade Unionism

by

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1. Introduction

The life-cycle models of human capital, developed by Ben-Porath (1967), Sheshinski (1968), Rosen (1972, 1973), Blinder and Weiss (1976), Hechman (1974, 1976) and others, assume that the skills which workers acquire from formal schooling or on-the job training are general, that is, of value equally to all firms in the labor market. This assumption is very important because general skills assure workers of free mobility among different kinds of jobs and free choice of human investiments by themselves. In such a world, as is well known[1], firms do not have any incentive to bear the cost of human investments, nor do they want to differentiate between the internal workers and the external ones. They only offer a wide variety of learning opportunities in the form of different conbinations of work-learning activities and wages, while workers choose the best one at each stage of life-cycle, according to the dynamic optimal policy of capital accumulation[2].

Within the above framework the life-cycle models with general skills analyzed the optimal time profile of investment in human capital for a worker, and provided a penetrating interpretation for the existing wages structures in the real world. However, if human capital investment takes the form of specific training, the drastic change of analytical framework will be required. That is, since skills aquired from on-the-job training are valuable only for a specific firm, workers must take into consideration not only the wage profile but also the possibility of quit or being laid off in the future. On the other hand, the firm, which is now in a monopsonistic position, must decide

its layoff policy and wage profile considering their effects on the quit rate and the total wage costs which the firm must bear in order to maintain the optimal level of employment. The most important thing to note here is that these considerations by individuals make the wage profile diverge from workers' productivity, and the lifetime wage structure becomes unable to be explained only by the accumulation of human capital.

Until a recent date, because of such complexities the models assuming the existence of specific human capital have not yet been fully developed in spite of the important efforts by Oi (1962), Parsons (1972), Pencavel (1972), Donaldson and Eaton (1976), and Mortensen (1978). These works concentrated on the implications of firm-specific human capital for labor turnover, but it seems to me that what the optimal properties of the employment contract are in the presence of specific training have not been discussed satisfactorily compared to the models with general human capital. However, Hashimoto following Kuratani (1973) attacked this problem in his recent work (1979, 1981). specifies his model according to Becker's view (1964, 22) that the parties to employment contract share the cost of investment in specific training and the returns on it, in order to reduce the likelihood of quit or layoff and to longer the recouping period[3].

I do not question here the general statement by Becker, but Hashimoto's specification. He presumes that the parties determine the worker's share (or the firm's share) in the returns to the specific training so as to maximize their joint gain. This presumption leaves

an important problem to answer because it does not necessarily hold that the optimal share obtained by maximizing their joint gain is coincident with the one which maximizes only the worker's income (or the employer's income) under consideration of the possibility of dismissal (or quit)[4]. That is, in general there is no incentives for both parties to maxmize their joint gain. By this reason the current paper which attempts to develop a theory of wage profile and layoff policy does not take the approach of the joint-gain maximization, but rather presumes that the firm maximizes its profit subject to a labor supply constraint. This Azariadis-type approach[5] will lead to the conclusions which differ from those reduced by the approach of joint-gain maximization.

The purpose of this paper is threehold. First, we consider the role of expectations of workers in the determination of the layoff policy of the firm. In the economy where workers can expect the layoff policy of the firm rationally and correctly, it is optimal for the firm not to lay off the skilled employees to a certain extent even if their marginal productivity is lower than wages. This employment policy strengthens the character of labor as a quasi-fixed factor, gives an economic rational to the so-called lifetime employment system in Japan, and does not contradict with seniority rule in U.S..

The second point is the following. In a two-period model, if the labor supply constraint is that over the two periods the expected present value of earnings in occupations with general skills must equal the expected present value of earnings in occupations with specific

skills, then employers hiring employees in whom they intend to create specific skills have an incentive to pay the lowest wage possible in period one and the highest in period two in order to lower the quit probability of the specific-skilled. This result was obtained by Nickell (1976), and Donaldson and Eaton (1976). Suppose, however, that capital markets are imperfact and workers do not have enough mortgages to finance their consumptions. Then this results does not necessarily hold. Since workers can not endure extremely low wages in period one, firms have to determine wage profiles taking account of the life-cycle pattern of consumption of workers as well as their effect on the quit probability of the skilled. Thus, wage profiles diverge from productivity, and get closely related to the amounts of consumption which workers plan at each stage of life-cycle, based on their lifetime incomes.

Finally, in the above framework this paper conduct comparative statics on the wage profile with respect to the variables which the behavior of unions may affect in order to understand the impact of unions in the presence of specific skills. According to Freeman (1976, 1980), Brown and Medoff (1978), and Medoff (1979), unions improve not only economic conditions but also social relations of production which results in decreasing the possibility of workers quitting and in increasing worker productivity.

In Section 2 the labor supply constraint which the firm faces in the labor market is presented. Section 3 discusses what factors prevent the firm from paying the lowest wage possible in the initial period and

how it determines its wage profile. In Section 4 the optimal properties of the firm's layoff policy are investigated focusing on the role of expectation of workers. In Section 5 we interpret the nature of wage profile in the presence of specific skills and explore its implications. Section 6 examines the impact of unions in our framework. In Section 7 we summarizes and concludes this paper.

2. Firm specific Training and the Labor Market

In the labor market there exist many different kinds of jobs which a worker can choose after formal schooling. One gives him a great deal of specific skills, specifically through on-the-job training, and another a lot of general skills. All these jobs must satisfy a certain condition on his wage if the labor market of the unskilled, that is, those who are going to work after formal schooling, is perfectly competitive. Let us assume, for the time being, that capital markets are perfect and workers are risk-neutral in this economy. Then, the market condition requires that the discounted present values of wages must be equal in all jobs.

In this paper we consider two-period model for simplicity. That is, a worker who can work for two periods acquire skills from on-the-job training in period one and possibly realize them in period two. If the acquired skills are all general, the worker can move freely among jobs for a higher wage in period two. Therefore, the firm does not have any incentive to bear the cost of human investment in general skills, while the worker does not care about the possibility of being

laid off by the firm or quitting it. Thus, the discounted present value of wages, W_g, which the worker with the level of formal scholling, K, can look forward to by choosing the general skill job g, is given by

$$W_g = aK - C_g + \frac{1}{1+r} a^*(H_g + K) \qquad (1)$$

where a, a*, C_g, r and H_g are the market value per unit of general skill in period one, the expected market value per unit of general skill in period two, the cost of human investment, the rate of interest, and general skills produced through on-the job training in job g, respectively. In this economy they are assumed to be given exogenously. It is also assumed that the nature of the skills aquired through formal schooling is general.

When job g is always available for the unskilled, a representative firm, which creates specific skills and utilizes them together with general skills, must pay them as high the present value of wages as they could obtain by choosing job g in period one. Otherwise, no one wants to be employed by that firm. Thus, the labor supply constraint for the representative firm is given by

$$W_g = w_1 + \frac{1}{1+r} \{(1-ly)(1-q)w_2 + [1-(1-ly)(1-q)]a^*(H+K)\} \qquad (2)$$

where w_1 and w_2 are the firm's wage profile, ly is the probability of being laid off which workers suppose on the firm, q is the probability of quit in period two, and H is the general skills which each worker can aquire from the on-the-job training in the firm. Here it is assumed that layoffs and quits occur independently in period two, and

workers can earn the wage which equals the value of their general skills in the other firms when they are separated from a specific firm.

The probability of quit in period two is given by

$$q = q(e) \tag{3}$$

$$e = w_2 - a^*(H + K) \tag{4}$$

where $q' < 0$ and $q'' > 0$.[6] This means that quits depend on the differential between the current wage and the alternative wage, which the worker can earn elsewhere through his general skills.

In this model it is assumed that workers are perfectly informed of the wage distribution across firms, but the contents of jobs and/or human relations in firms are not perfectly known to them. That is, workers do not know exactly what kind of job it will be, or what characters their supervisors and colleague have. Therefore, it is possible thtat after having obtained skills they find their jobs uninteresting and boring, or come into collision with the others in the firm. In addition, there are private reasons for workers to quit. For example, their families might migrate to other regions, or they might be forced to change the jobs for the sake of marriage or bad health. In any way it does not appear unrealistic to assume that these motives to quit can be partially compensated by the wage differential between the current and the alternative, as expressed by (3).[7]

3. The Optimal Policies of the Firm and the Imperfect Capital Market

We consider the firm which produces a single product for selling

in the product market and maximizes the expected present value of profit. Labor, which embodies general skills and/or specific skills, is the only factor of production for the firm. Let F_k be the marginal value productivity of an untrained worker whose level of schooling is K. Since the firm creates specific human capital and general human capital in him through on-the-job training in period one, his marginal productivity increases. Let M_k be the marginal value productivity of the trained worker in period two.

M_k is a random variable because it depends mainly on the uncertain condition of the product market in period two. We represent its subjective density function by $f(M_k)$. If M_k turns out to be low in period two by the decline of product demand for the industry, the firm might lay off the skilled. Suppose that M_k° is the critical point below which the skilled are laid off. Then the possibility of layoff is given by

$$ly = \int_{-\infty}^{M_k^\circ} f(M_k)\, dM_k$$

where M_k° is determined by the employment policy of the firm.

Considering that the market value per unit of general skill and M_k are random variables, and assuming that they are independent, the expected present value of the firm's profit, R, from hiring an untrained worker is given by

$$R = F_k - C - w_1 + \frac{1}{1+r}(1 - q)(1 - ly)(M_k^* - w_2) \qquad (5)$$

$$M_k^* \equiv \frac{\int_{M_k^\circ}^{\infty} M_k f(M_k)\, dM_k}{1 - ly}$$

where the cost of human investment, C, is given exogenously. Thus, the firm determines its wage profile (w_1, w_2) and layoff policy (M_k°) by maximizing R subject to the labor supply constraint (2).

But our problem is not so simple. After substituting (2) into (5), we get the partial derivative of R with respect to w_2,

$$\frac{\partial R}{\partial W_2} = - \frac{1}{1 + r} q'(1 - 1y)[M_k^* - a^*(H + K)] > 0$$

which is always positive because the expected conditional value of a worker in the particular firm is greater than that in other firms by his possession of specific skills in period two. Needless to say, this is the core assumption of specific training. Thus, it is rational for the firm to reduce its period one wage to the lowest possible level and raise its period two wage to the highest level. The firm can benefit from decreasing the quit probability of the skilled because it retains more specific skills within the firm and reduces the wage costs to bear[8].

Clearly this result is not realistic in the sense that, if this policy is taken by the firm, the period one wage should become negative, contrary to the fact that most of initial wages which workers start with are really positive. Then, what makes firms refrain from reducing initial wages to the negative in the real economy? We can imagine three possible factors to do so, that is, the minimum wage law, risk-aversion on the part of workers, and imperfection in the capital market.

If the minimum wage law dominates as a lowest level, all the initial wages of firms which create specific skills must be equal to the minimum wage. However, this contradicts the fact that initial

wages differ widely and appear to depend on the expected lifetime incomes. As many empirical studies on wage profiles show[9], the more the future income is expected from the job, the higher is its initial wage.

If workers are a risk-averter, the uncertainty of being laid off or quit in period two makes them concerned about not only the present value of wages but also the wage profile. This means that the low wage in period one can not attract workers in the competitive labor market unless it is compensated by the extremely high wage in period two. Therefore, firms which minimize wage costs as far as their circumstances permit avoid such steep wage profiles.

When workers can not borrow money enough to finance their consumptions because of imperfection in capital market, steep wage profiles mean that they are forced to consume a small amount in period one and a large amount in period two, no matter how their desirable consumption patterns are. It is, however, possible that workers prefer to consume more in period one and less in period two even if the total amount of wages which they can receive becomes smaller. In such a case, firms can save wage costs by making wage profiles flatter. In fact, this situation is very likely to occur because the properties to mortgage and/or the opportunities to borrow against future earnings are severely limited for the workers who have just finished their academic careers. It should, however, be stressed here that imperfection in capital markets is asymmetric in general, that is, workers can not borrow sufficiently, but can lend money at the proper interest rate as

mush as they want.

Taking account of risk-aversion and imperfection in the capital market, we can represent the worker's utility, U, like this,

$$U = u(w_1) + (1-q)(1-1y)v(w_2) + [1 - (1-q)(1-1y)]v(a^*(H+K))$$

where u and v are the utility function in period one and in period two, which are assumed to be monotone increasing and concave. It is also assumed that the worker can not borrow in the capital market at all.

If the earnings from job g in period one, $aK - C_g$, is relatively high and not binding against the worker's optimal plan of consumption over time, then his consumption profile (c_1, c_2) is such that

$$\frac{1}{1+r} = \frac{v'(c_2)}{u'(c_1)}$$

$$W_g = c_1 + \frac{1}{1+r} c_2$$

and he obtains the maximum utility, U_g. Therefore, the labor supply condition requires

$$U_g = u(w_1) + (1-q)(1-1y)v(w_2) + [1 - (1-q)(1-1y)]v(a^*(H+K)). \quad (6)$$

Thus, the firm determines M_k°, w_1 and w_2 by maximizing the expected present value of profit, R, under the condition of (6). Letting L and λ be the Lagrandian function and the multiplier, we have the first-order necessary conditions[10],

$$\frac{\partial L}{\partial M_k^\circ} = (1-q)f(M_k^\circ)\{-\frac{1}{1+r}(M_k^\circ - w_2) + \lambda[v(a^*(H+K)) - v(w_2)]\} = 0 \quad (7)$$

$$\frac{\partial L}{\partial w_1} = -1 + \lambda u'(w_1) = 0 \tag{8}$$

$$\frac{\partial L}{\partial w_2} = q'(1-ly)\{-\frac{1}{1+r}(M_k^* - w_2) - \frac{1-q}{q'}(\frac{1}{1+r} - \lambda v'(w_2))$$

$$+ \lambda[v(a^*(H+K)) - v(w_2)]\} = 0 \tag{9}$$

$$\frac{\partial L}{\partial \lambda} = u(w_1) + (1-q)(1-ly)v(w_2) + [1 - (1-q)(1-ly)]v(a^*(H+K)) - U_g$$

$$= 0 \tag{10}$$

4. Optimal Layoff Policies and Rational Expectation

Before exploring some properties of the optimal layoff policies, we specify the density function of M_k as follows,

$f(M_k) > 0$ if $M_k > \underline{M}_k$

$f(M_k) = 0$ if $M_k \leq \underline{M}_k$

where $\underline{M}_k$ stands for the maximum level of the marginal product whose probability of occurence is expected to be zero. This specification is only to exclude the case of multiple optimal solutions.

Using (8), we can rewrite the optimality condition (7) in a form which is readily interpretable,

$$M_k^\circ - w_2 = -(1+r)\frac{1}{u'}[v(w_2) - v(a^*(H+K))] < 0 \quad \text{if } M_k^\circ > \underline{M}_k \tag{11}$$

$$ly = 0 \quad (f(M_k^\circ) = 0) \quad \text{if } M_k^\circ \leq \underline{M}_k \tag{12}$$

According to the position of $\underline{M}_k$ we must consider three cases as the figures show; case 1 ($\underline{M}_k < M_k^\circ < w_2$) in Figure 1, case 2 ($M_k^\circ \leq \underline{M}_k < W_2$) in Figure 2, and case 3 ($M_k^\circ < w_2 \leq \underline{M}_k$) in Figure 3.

(Layoffs can occur)

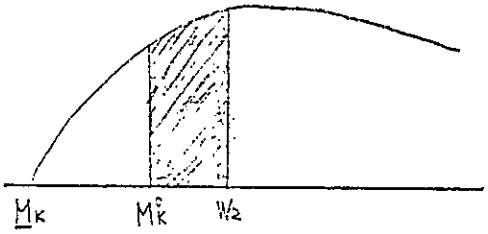

Figure 1

(No layoff)

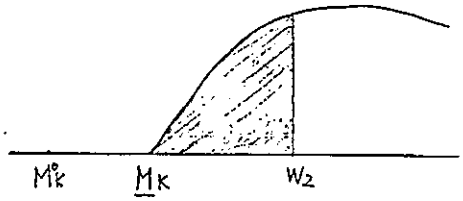

Figure 2

(No layoff)

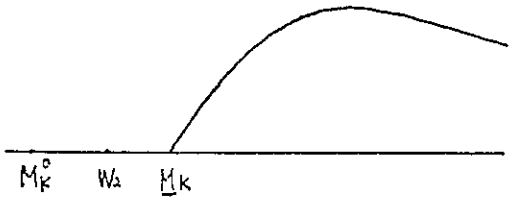

Figure 3

Here it is interesting to note that, when the ex post value of M_k falls between M_k° and w_2 in case 1 or between $\underline{M}_k$ and w_2 in case 2 (the shaded areas in Figures), the firm does not lay off the skilled even if their wage is higher than their marginal productivity. It is only when M_k falls between $\underline{M}_k$ and M_k° in case 1 that the firm lays off the skilled. This "labor hoarding" phenomenon is explained in the following manner.

If the firm facing a demand decline lays off the senior workers, that is, the skilled, it will immediately have a bad reputation and be retaliated in the form of rising wage costs under the pressure of the unskilled labor market. Therefore, it is rational for the firm to avoid the layoffs of the senior workers as much as possible[11].

These conditions on layoffs are different from those of Oi (1962) and Hashimoto (1979, 1981). They considered that even under the existence of specific skills workers are laid off when their marginal productivity falls below their wages. In our framework their condition can be obtained by modifying the assumption on the expectation of workers as follows: So far the workers are assumed to be able to rationally expect the layoff policy of the firm. This is the reason why the identical probability of layoff appears both in the equation (5) and (6). But, if the workers assume another layoff policy, ly*, which is determined independently of the firm's policy, because of their misconception or inability to expect the firm's behavior correctly in the short run, then the optimality condition for the firm is such that

$$M_k^\circ - w_2 = 0 \qquad \text{if} \quad M_k^\circ > \underline{M}_k \qquad (11)'$$

$$ly = 0 \qquad \text{if} \quad M_k^\circ \leq \underline{M}_k \qquad (12)'$$

which are essentially the same as their condition.

Special attention must be paid to an aspect of this model that, as is clear from our setup on the time span, layoffs dealt with here mean the permanent termination of employment of the skilled. In other words, this model does not deny the existence of the temporary layoffs discussed by Feldstein (1976) and Baily (1977), or rather supports

their basic assumption, that is, "the relatively permanent attachment of workers to individual firms" with the frequent spells of temporary unemployment.

The analysis in this section appears to provide an economic rational for the so-called lifetime employment system in Japan, and does not contradict with seniority rule in the U.S.[12]. Both systems are the same in the sense that they aim at protecting the skilled from being laid off. However, it should be stressed here that, while the seniority rule is formal and clearly-defined, the lifetime employment system is not so, but rather the common expectation (or the norm) that employment relations will (or should) continue until old age retirements. This vagueness leads to the situation that we can not empirically ascertain its real effects on the layoff policies since the productivity of a worker is neither coincident with his wage in the presence of specific skills, nor unable to be measured directly by the outsiders of the firm. This makes it possible for us to imagine another story about the employment relations in Japan.

Now the Japanese people are possessed with the stereotyped idea that permanent employment strongly characterizes the Japanese industrial relations[13]. Owing to the rapid rate of economic growth and the intense demands for the skilled at least since Taishō era (1912-1926), the Japanese workers have seldom experienced large scales of layoffs and have had no chance to know how the firms' layoff policies are in severe times. On the other hand, the mobility of workers has been limited not only by nenkō-rule, that is, the wage and promotion system

according to age and length of service, but also by steep wage profiles[14]. Hence, the Japanese people easily adopt the permanent employment characterization by Abegglen (1958).

In this situation, as is shown in this section, it is rational for the firms to reduce their wage costs by firing the senior workers, whose wages are relatively high. In fact, this behavior has been occasionally taken at the recent recessions specifically since 1973, what is called the year of oil shock, against our image of the lifetime employment in Japan, and the difficulty of the senior workers in finding a job has become a serious problem in Japan. In addition, more recently, some firms notably in the ship-building industry hired new junior workers after they had dismissed the senior workers two years before. This behavior indicates that the Japanese firms do not take the policy of "labor hoarding". Thus it is quite possible that there has not existed the lifetime employment system in fact, but only the make-believe phenomenon caused by the rapid rate of economic growth. Otherwise, we have to interpret it as a symptom which shows that the lifetime employment system is now collapsing in Japan (see Galenson and Odaka (1976)).

5. On the Determinants of the Wage Profile

In the case where every kinds of skills are general wages are equal to workers' productivity since workers can move freely among jobs and bear all the costs of human investments. But in the presence of firm-specific skills wages are forced to diverge from productivity. Using our model, we can explicitly present this fact by substituting (8) into

(9),

$$\frac{1}{1+r}(M_k^* - w_2) = \frac{1-q}{-q'}\left(\frac{1}{1+r} - \frac{v'(w_2)}{u'(w_1)}\right) + \frac{1}{u'(w_1)}[v(w_2)-v(a^*(H+K))] \tag{13}$$

Equation (13) clearly shows us that, in addition to productivity, the possibility of layoff (M_k°), the elasticity of the retention rate of the worker with respect to wage ($\frac{-q'}{1-q}$), the degree of the worker's risk-aversion $[v(w_2) - v(a^*(H+K))]$[15], earnings in other firms $[a^*(H+K)]$, and the distortion of consumption plan $\left(\frac{1}{1+r} - \frac{v'(w_2)}{u'(w_1)}\right)$ have effects on the wage-productivity gap. Here in this paper we focus on the role of the consumption pattern of the worker in the determination of the wage profile because it has interesting implications for the current issues.

Assuming that case 1 occurs and substituting (11) into (13), we have

$$\frac{1}{1+r} - \frac{v'(w_2)}{u'(w_1)} = \frac{1}{1+r}\left(\frac{-q'}{1-q}\right)(M_k^* - M_k^\circ) > 0 \tag{14}$$

where inequality holds because M_k^* is the conditional expectation of M_k when $M_k > M_k^\circ$. This result means that in period one the workers consume less than they would do in perfect capital markets or under unbinding wage profiles. This distortion of consumption plan must be compensated by the relatively high wage in period two because the wage profile of job g is assumed to be unbinding. If the firm reduces the period one wage more, the distortion increases disproportionately by the concavity of the worker's utility function. This is one of the reasons why the firm refrains from reducing the period one wage infinitely[16].

This analysis has some interesting implications for the current issues.

Compared with his marginal productivity in a particular firm, a worker's consumption pattern is likely to be relatively stable because it is determined on the bases of his expected permanent income and "life style". Therefore, the close relation between wage and consumption pattern under the existence of specific skills, which work as a buffer absorbing short-run variations in workers' productivity, can be considered to make wage profiles stable in the course of business fluctuations[17].

The close relation between wages and consumption pattern provides an interesting interpretation for the existing wage profiles. In Japan many labor economists affected by Marx insist that the Japanese wage profiles, what is called nenkō-wages, correspond to the living expenses which workers need at each stage of life-cycle to reproduce their own labor forces. But this hypothesis is always exposed to the criticism that paying higher wages to senior workers is not consistent with the profit maximization of competitive firms unless their skills are well worth it. In a sense the discussion in this paper will give an economic rationale to the living expense hypothesis in the framework of human capital theory.

In U. S., using the personnel records of two major corporations, Medoff and Abraham (1978) found the facts that, concerning managerial and professional employees within grade levels, there is either no association or a negative association between experience and relative performance while there is a strong positive association between experience and relative earnings. These findings imply that wage

profiles are rising independently of changes in productivity and the human capital models assuming only the existence of general skills can not explain its phenomenon. It is clear that the model presented in this paper provides an explanation for their findings by paying attention to the relation between wage profile and consumption pattern in the presence of specific skills.

6. The Impact of Trade Unions

Recently a new view on the impact of trade unionism has been presented by Freeman (1976, 1980), Brown and Medoff (1978), and Medoff (1979). They argue that trade unions work to improve not only economic conditions for workers but also social relations in the team production, which strongly affect the probability of workers quitting and the productivity of workers, as will be explained in detail later. In this section we will examine, along the line of their discussions, what effects the trade union have on the optimal wage profile of the firm, confining analysis to case 2 or case 3 where the worker can expect the layoff policy of the firm rationally and $M_k^\circ \leq \underline{M}_k$ holds, that is, the probability of layoff for the skilled is zero[18]. Furthermore, to simplify the analysis on the effects of the union on the worker's quitting, we specify the quit function as linear[19]. Thus the optimal wage profile for the firm is determined by the following system.

$$q = \alpha - \beta[w_2 - a^*(H + K)] \qquad \alpha > 0, \quad \beta > 0 \tag{15}$$

$$\frac{1}{1+r}\beta(M_k^*-w_2) = q\left(\frac{1}{1+r} - \frac{v'(w_2)}{u'(w_1)}\right) - \beta[v(w_2) - v(a^*(H+K))]\frac{1}{u'(w_1)} \tag{16}$$

$$u(w_1) + (1-q)v(w_2) + qv(a^*(H+K)) = U_g \qquad (17)$$

First, we examine the effect of "union power" of improving economic conditions for workers, which can be represented by an increase in U_g in our system. This way of understanding union power is in essence traditional, but differently supposes that the union entirely submit wage rationing between the skilled and the unskilled to the firm because it is a delicate and controversial problem for the union to ration wage gains among the members who differ in their own interests.

The analysis in Appendix A demonstrates that union power raises both wages in period one and in period two, and suppresses the quits of the skilled accordingly. This result simply means that since the marginal gain from increasing w_2 decreases by the concavity of the utility function of the worker, the firm rationally divides into two periods the union-induced increase in the amount of wage payment.

It is rather interesting to pay attention to the change in the slope of the wage profile. Unfortunately we can not say decisively about its sign, but can realize from Appendix A that the larger the gap between w_2 and $a^*(H+K)$ is, the more the firm increases w_2, because the marginal gain from suppressing the quit rate of the skilled becomes higher by its increased gap. The other interesting thing is that the larger the consumption distortion is, the more the firm raises w_1 since the large distortion penetrates the firm in the form of unnecessarily rising wage costs to satisfy the union-induced increase in the level of U_g.

Applying the exit-voice model of the social system advocated by

Hirschman (1970) to the labor market, Freeman (1976, 1980) discussed that unionism reduces quits and permanent separations by providing a "voice" alternative to classical exit behavior when workers are dissatisfied with conditions, and presented empirical evidence showing significantly lower exit for unionist by analysing data on individuals. More specifically, he pointed out three aspects of trade unionism . . as an institution of worker voice; the grievance and arbitration system which offers dissatisfied workers an means of solving discontent before quitting, the information system of communicating true worker preferences on work conditions and rules to the management, the industrial jurisprudence system under which managerial authority is diluted by many work place decisions made on the basis of collectively-negotiated rules such as seniority. These systems of unionism produce the exit-voice tradeoff and work to reduce exit behavior regardless of the union impact on wages and fringe benefits.

Interpretting the voice behavior of union as an element shifting the quit function of the firm autonomously, we analyse the effects of an change in α on the optimal wage profile. Appendix B shows that an decrease in α lowers w_2, but its effect on w_1 is ambigous because of two incompatible effects. One is that since the decrease in α raises the marginal cost of w_2 by $\left(\frac{1}{1+r} - \frac{v'(w_2)}{u'(w_1)} \right)$ through reducing the quit possibility of the senior workers receiving a high wage, the firm lowers w_2 and instead raises w_1 to satisfy the labor supply constraint. The other is the cost-saving effect which the increase in α brings about by relaxing the supply constraint. That is, because the reduction in

the possibility of quit increases the expected utility of a worker, the firm becomes able to satisfy the supply condition with less wage costs, lowering both w_1 and w_2. Clearly this effect is the same kind as that of the decrease in U_g. Thus, if we assume that the consumption distortion is sufficiently large or that the cost-saving effect is squeezed out by union power increasing U_g, the voice behavior of union makes the wage profile flatter.

Finally we consider the impact of unionism on worker productivity. According to Freeman (1976) and Brown and Medoff (1978) trade unions have a substantial positive effect on output per worker through affecting the firm-specific investments in human capital; social interactions among workers, disputes between workers and supervisors, the moral of workers, and motivation. In our system this positive effect of the union on productivity can be represented simply as an increase in M_k^*. Here it should be noted that, as can be seen in equation (16) and (17), the investment in human capital (C) and the marginal productivity of the unskilled (F_k) do not have any influence on the determination of the optimal wage profile.

From Appendix C we know that, when M_k^* rises, the firm makes its wage profile steeper by reducing w_1 and by raising w_2 in order to refrain the skilled who now became more valuable for the firm from quitting. It is clear that this policy requires the firm to bear wage costs more than before in total because the large consumption distortion must be compensated by a greater amount of wage payment. Here again we know that the consuption distortion is associated with the effects of

the union on the wage profile.

Summing up this section, the impact of the trade union on the wage profile is not decisive while that on the quit rate of the skilled through increasing the period two wage or voicing is clear. However, we can insist that the magnitude of the consumption distortion plays a crucial role in the process that the union affects the behavior of the firm optimizing the wage profile. That is, when the distortion is already large, unionization gives the firm an incentive to make the slope of the wage profile smaller.

7. Summary and Some Further Extension

This paper attempted to develop a theory of wage profile and layoff policies in the presence of firm-specific training, and examined the impact of unionism on wage profiles. The derived conclusion on the optimal properties of layoff policy is that, in the economy where workers are very sensitive to firms' layoff policies and expect them rationally, it is optimal for firms not to lay off the skilled employees to a certain extent even if their marginal productivity is lower than wages. This provides an economic rationale for the lifetime employment system in Japan and does not contradict with seniority rule in U.S..

It was also discussed how wage profiles diverge from productivity under the existence of specific skills and get related to the workers' consumption pattern over time in imperfect capital markets. Workers can not tolerate the extremely steep wage profiles since their financial

ability for consumption are limited in imperfect capital markets, so that firms must take account of not only their effect on the quit rate of employees but also the consumption pattern of workers in the determination of wage profiles.

Trade unions improve not only economic conditions for workers but also social relations of productions, which leads to the reduction in the probability of workers quitting and to the increase in the productivity of workers. While the effect of these union activities on the quits of the skilled is deterministic, that on wage profiles is not so. It strongly depends on the consumption distortion created by steep wage profiles which workers tolerate at that time. That is, when the distortion is sufficiently large, unionization makes wage profiles flatter.

An important problem remains for further extention in this paper. That is to say, the amount of human capital and of investment were assumed to be given exogenously here. But it appears more realistic to assume that human capital depends on the investment which firms determine. In the current paper we ignored this phenomenon to focus on the particular problems of wage profile and layoff policy. The discussion on the determination of human investment is rather interesting from the point of view of income distribution in the sense that in such a economy inequality among workers is generated by firm-maximizing behaviors.

FOOTNOTES

1. See Becker (1964) for example.
2. Rosen (1927b) discussed the logical structure in the life-cycle models with general skills.
3. The setup of Hashimoto's model is essentially the same as that of Kuratani's, but I will mainly refer to the former by the reason that his paper is easily available to the readers.
4. Hashimoto justifies his presumption by quoting the following discussion by Becker (1962, 21): "Specific, unlike general, training would produce certain 'external' effects, for quit would prevent firms from capturing the full return on costs paid by them, and layoffs would do the same to employees. Note, however, that these are external diseconomies imposed on the employees or employers of firms providing the training, not external economies accruing to other firms". The problem is similar, but not quite the same as that of public economics. For, as is well known, the social optimum in the supply of public goods or bads can be obtained independently of the income distribution among the parties as far as we ignore the problem of moral hazard. Mortensen (1978) clearly shows this.
5. See Azariadis (1975).
6. A dash means a derivative hereafter.
7. This justification for the responsiveness of quit to e requires some qualification in equation (2). Suppose that the disutility of a job's attributes can be measured in terms of money and represented by x. Since the attributes are not known to a worker upon

becoming employed by a firm, x is a random variable. Further assume that, when a worker quits a firm to solve his problem, he expects the disutility of z^*, which is less than the expectation of x because he can turn over from firm to firm within period two. Thus, if $x - z^* > e$, the worker will quit the firm with the income loss of e. When he remains ($x - z^* \leq e$), he must suppress his job dissatisfaction. On the other hand, if a worker chooses job g, the expected disutility in period two will be z^*. Thus, the difference in the expected disutility between job g and the specific-skill job can be written as

$$\frac{1}{1+r}\{z^* - (1-ly)(1-q)s^* - [1 - (1-ly)(1-q)]z^*\}$$

$$= -\frac{1}{1+r}(1-ly)(1-q)(s^*-z^*)$$

where s^* is the expected conditional disutility when $x - z^* \leq e$. The sign of this term is ambiguous. If $s^* > z^*$, the earnings on the specific-skill job must be discounted since the term is nagative, and vice versa. It depends on how often a worker can turn over in period two. For z^* becomes smaller the easier the worker's turnover. But in this paper, for simplicity of exposition, we neglect this qualification by assuming that s^* is approximately equal to z^*. This is also done implicitly in the paper of Nickell (1976), and essentially the same as that of Donaldson and Eaton (1976).

8. Nickell (1976) and Donaldson and Eaton (1976) obtained the same conclusion as this paper, only when quit probability is taken into consideration in the labor supply constraint. On the other hand,

when Donaldson and Eaton consider layoff probability instead of quit in the constraint, the opposite conclusion was derived that the firm offers a declining wage profile as an optimal policy.

9. See Hanock (1967) or Mincer (1974) as a representative.

10. The level of employment of the unskilled is determined so as to hold R = 0 at equilibrium. If we attempt to analyse its determination closely, production technology of the firm must be specified explicitly. But it makes our current problems much complex.

11. Parsons also showed that "before layoffs will be undertaken in the first period, the worker's net marginal product in that period must be negative to the point that it offsets the direct layoff costs as well as expected future production losses, since some laid-off workers will not be abailable for rehire. If all laid-off workers could be rehired, only first-period net productivity would enter the decision, ..." (1972, p. 1126). The time span assumed in Parsons's model is shorter than in this model in the calendar time, since the period two in this model means the rest of working-life of the worker after he obtained skills. Therefore, if we can ignore the direct layoff costs as negligible in the long run, this model says that layoffs will not be undertaken even if the current value of marginal product less wages is negative and the expected future production losses by layoffs are positive.

12. See Seniority in Promotion and Transfer Provisions.

13. It is generally agreed that the lifetime employment system applies to regular employees in large-scale enterprises (1000 or more

employees) and some medium-scale firms (100-999 employees) in the private sector and regular employees in the public sector.

14. According to Shimada (1974), wage profiles in Japan are generally steeper than those in the U.S.

15. Conducting Taylor expantion on $v(w_2)$ and neglecting terms of order higher than second, we have the following approximation,

$$v(w_2) - v(a^*(H+K)) = [w_2 - a^*(H+K)]v' + \frac{1}{2}[w_2 - a^*(H+K)]^2 v' \frac{v''}{v'}$$

whose value depends on the worker's absolute risk-aversion $(-\frac{v''}{v'})$

16. When case 2 or case 3 occurs, we can not say anything decisively about the sign of $(\frac{1}{1+r} - \frac{v'}{u'})$ from equation (13). That is, it can be negative if the worker's risk-aversion is sufficiently large. But the assumption of asymmetric imperfection in the capital market discards this negative case. If it is negative, the worker cuts down their consumption in period one, lends money at the rate of interest (r), and consumes more in period two up to the point at which equality is attained. In this case, imperfection in the capital market becomes irrelevant to the determination of the wage profile since the firm takes into consideration only the worker's risk-aversion.

17. Parsons (1972) analyzed how the firm manipulate its wage profile to deal with the different market situations, that is, a time of declining product demand and a period of prosperity. This means that the firm utilizes the wage profile to adjust employment in response to the demand fluctuations. In contrast, the wage profile in this model is determined from the point of view of supporting workers' consumptions, so that it is not responsive to the short run fluctuations.

18. This assumption is also justified by the union strength which forces the firm to apply a seniority rule to layoffs.

19. This specification is not essential to our conclusions.

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