RESEARCH BULLETIN
OF NARUTO UNIVERSITY
OF EDUCATION
Volume 33 2018

Firm-Specific Human Capital and Employment Period

AOBA Nobuko*

(Keywords: firm-specific human capital, employment period)

1. Introduction

The temporary employment rate has been increasing rapidly in Organisation for Economic Co–operation and Development (OECD) countries since the 1980 s. According to the OECD (2004), the percentage of youth in regular employment is decreasing because employment protection legislation covers regular but not temporary employment. Blanchard and Landier (2002) demonstrate that the youth unemployment rate increased because employment under fixed–term contracts and, in turn, the turnover rate of low–skilled occupations, increased with deregulation.

There are well–known substitution effects in different age groups in Japan in which youth employment and wages are affected by the employment and wages of other age groups. Japan entered a recession in the 1990 s and the protection of older regular employees restrained youth employment. Such substitution effects often occur in countries in which there is strong employment protection for regular employment and there are difficulties in adjusting employment to business fluctuations. Piore (1970), Doeringer and Piore (1971), Umemura (1971), and Nakamura (1975) analyze employment adjustment by temporary workers. They explain that the youth temporary employment rate increases because employment protection for regular employment has been strong and temporary workers have become a buffer for business fluctuations.

The distinctive features of the Japanese employment system are the lifetime employment system and employee training within large enterprises. Traditionally, young people have been hired mainly by large enterprises immediately after graduation, and their career paths after joining companies have been based on Japanese employment practices. While regular employment workers receive training to acquire skills necessary for their tasks, temporary employment workers have little job training. Many regular workers remain at the same enterprises for a long time because of low liquidity of labor markets, but it is difficult for temporary employment workers to become regular employment workers.

The environment facing firms is changing and business innovations are required to maintain competitiveness. Generally, business innovations do not include technological factors, such as innovations in sales methods, design innovations, innovation of services, and purchasing innovation of new products. We suppose that skilled technical personnel generate innovation. If a firm does not carry out human resource development from a long–term perspective, it cannot maintain competitiveness. The purpose of this study is to analyze how employee training effects employment period.

Section 2 presents a simple survey of previous approaches to such research. Section 3 explains the relationship between firm–specific training and employment period. Section 4 explains labor supply. Section 5 develops the basic model. Section 6 analyzes long period employment, Section 7 analyzes short period employment, and Section 8 compares the two. Section 9 discusses Japanese employment practices and concludes.

*Naruto University. Nakajima 748, Naruto, Naruto-shi, Tokushima 772-8502, Japan. E-mail: aoba@naruto-u.ac.jp.

2. Previous Research Approaches

According to the analysis of firm-specific human capital, the cost of and returns on training investment are shared by the worker and the employer. This argument is originally advanced by Becker (1962, pp.10 – 15). Hashimoto (1981) demonstrates that the Becker hypothesis can be viewed as a direct application of the Coase theorem. Flamholtz (1985) lists three conditions necessary for human capital to be recorded as an asset: (1) the firm can acquire the benefit as long as the worker remains with the firm, (2) the firm can control the benefit, and (3) the benefit can be measured in monetary terms. Bouillon, Doran, and Orazem (1996) demonstrate that two measures of firm investment in human-specific capital are significantly and positively correlated with long-term rates of return on investment. However, how employee training affects their employment period has never been analyzed. The environment facing firms is changing and it is necessary for business innovations to maintain competitiveness. Firm-specific training has the effect of generating innovations. In this study, we analyze the relationship between firm-specific training and employment period by focusing on this innovation effect.

3. Firm-specific Training and Employment Period

Firm-specific training increases the employee's value of marginal product. The effects of firm-specific training increase with employment period. Firm-specific training increases long-term rates of return on investment and the return on the investment will be shared by the worker and the employer. In OECD countries, employment protection legislation for regular employment is stronger than for temporary employment and the employment period of regular workers is longer than that of temporary employees. Therefore, most firm-specific training is provided for regular workers.

Firms need to be able to adjust employment when the economy worsens. However, employment protection legislation makes it difficult to do so. Therefore, firms that have many regular employees are at a high risk of bankruptcy. We call this the risk of employment adjustment. On the other hand, firms that have many low productivity workers are at a high risk of being unable to maintain competitiveness when the environment changes in the future. We call this the risk of obsolescence. We use the risk of obsolescence to analyze the relationship between firm-specific training and employment period.

In this study, a model consisting of two consecutive periods (specified by three points in time) is proposed. The labor market includes firms and workers. At the start of the first period, workers are recruited. For simplicity, we assume that the productivity of workers is homogeneous at the beginning of the period. Employed workers are assumed to receive firm-specific employee training and increase their productivity. Workers who are employed for a long period are protected by employment legislation. At the start of the first period, the price in the second period is uncertain. If the products are in fashion, the price in the second period is not less than the price in the first period. If the products are out of fashion, the price in the second period is less than the price in the first period and the risk that profits become negative increases. We denote by g the probability that the products of firms are in fashion the second period, and denote by $1-g$ the probability that the products of firms are out of fashion in the second period. Firms and workers know these values. At the start of the first period, profits in the second period are uncertain, and we treat them as a probability variable.

4. Labor Supply

First, we consider the utility-maximizing behavior of workers. Let U denote the utility function of a representative worker. For simplicity, we assume that workers obtain satisfaction from consuming goods and work leisure. We denote x as consumption of goods and l as the consumption hours of leisure. The utility of the worker, U, is an increasing concave function of individual consumption of goods x and consumption hours of leisure l. That is, $U=U(x, l)$, $\partial U/\partial x>0$, $\partial^2 U/\partial x^2<0$, $\partial U/\partial l>0$, $\partial^2 U/\partial l^2<0$.

The person's consumption of goods and leisure is constrained by his/her time and income. Part of the person's income is independent of the number of hours worked. We denote this non-labor income by M, the number of hours the individual works by h, and the hourly wage rate by w. For simplicity, we assume that the price of goods is 1.

Then, the person's budget constraint is written as follows.

$$x=wh+M \tag{1}$$

We assume that the wage rate is constant for a particular person, so that the person receives the same hourly wage regardless of the number of hours he or she works. Generally, the marginal wage rises with the hours of work. However, we ignore the possibility that a worker's marginal wage depends on the number of hours worked. For simplicity, non-labor income is assumed constant.

We assume that the person spends the time he or she has on either work or leisure. The total time allocated to each of these activities equals the total time available in the period. We denote the total time by T. That is, $T=h+l$.

The worker chooses the particular combination of goods and leisure that maximizes his or her utility considering the limitation imposed by the budget constraint.

$$\underset{x,l}{Max.}\ U(x, l)$$

$$s.t.\ x=w(T-l)+M$$

From the first-order condition is

$$\frac{MU_l}{MU_x}=w \tag{2}$$

The optimal consumption of goods and leisure for the worker is given by the point at which the budget line is tangential to the indifference curve. That is, the marginal rate of substitution equals the wage rate. The marginal rate of substitution refers to the rate at which the worker is willing to give up leisure hours in exchange for additional consumption. Therefore, at the optimal point, the marginal value of leisure equals the marginal cost of leisure.

From (2),

$$\frac{dw}{dl}=\frac{\frac{\partial U}{\partial x}\left[\frac{\partial^2 U}{\partial l^2}+\frac{\partial^2 U}{\partial x\partial l}\frac{dx}{dl}\right]-\frac{\partial U}{\partial l}\left[\frac{\partial^2 U}{\partial x^2}\frac{dx}{dl}+\frac{\partial^2 U}{\partial x\partial l}\right]}{\left(\frac{\partial U}{\partial x}\right)^3}=-\frac{1}{\left(\frac{\partial U}{\partial x}\right)^3}\begin{vmatrix}\frac{\partial^2 U}{\partial x^2} & \frac{\partial^2 U}{\partial x\partial l} & \frac{\partial U}{\partial x}\\ \frac{\partial^2 U}{\partial x\partial l} & \frac{\partial^2 U}{\partial l^2} & \frac{\partial U}{\partial l}\\ \frac{\partial U}{\partial x} & \frac{\partial U}{\partial l} & 0\end{vmatrix} \tag{3}$$

The determinant is positive, because $U=U(x, l)$ is an increasing concave function. From $\partial U/\partial x>0$, $dw/dl<0$, $dw/dh>0$. The marginal value of leisure will diminish as the individual obtains more and more leisure (the law of diminishing marginal utility). Therefore, the wage rise decreases leisure and increases labor. For analytical convenience, we assume that the wage and hours of labor have a linear relationship, and that there is an inverse labor supply function. Let R denote the labor hours of a representative worker and w the wage of a representative worker. Then, the inverse labor supply function is as follows:

$$w=a+bR,\ a\geq 0,\ b>0. \tag{4}$$

Firm-specific training increases the need for employees to concentrate on their jobs as well as their value of marginal product. We suppose that the increase in the need for concentration reduces the utility of the worker. That is, firm-specific training is assumed to induce an upward shift of the labor supply function. By denoting the firm-specific training cost per worker as t, we assume that a is an increasing concave function of t, $(da/dt)>0$ and $(d^2a/dt^2)\leq 0$. Then, the inverse labor supply function of the worker that undergoes firm-specific training is as follows.

$$w=a(t)+bR,\ \ a'<0 \tag{5}$$

5. Basic Model

In this section, a one-period model is proposed. We formulate the profit function of firms using the inverse labor supply function of the worker. At the start of the period, firms employ workers. For simplicity, we assume that the productivity of workers is homogeneous at the beginning of the period. We denote by R the number of workers and by y the products of workers. We assume that the products are an increasing concave function of the number of workers. That is, $y=y(R)$, $dy/dR>0$, $d^2y/dR^2<0$.

Workers are assumed to receive firm-specific employee training and increase their labor productivity. We denote the rate of increase of products after training as r and assume r is given. We define p as the price of the product. Then, the profit function to reflect these training effects is specified as follows.

$$\Pi=(1+r)y(R)p-wR-tR \tag{6}$$

Substituting the inverse labor supply function (5) into Eq.(6) yields

$$\Pi=(1+r)y(R)p-(a(t)+bR)R-tR \tag{7}$$

Generally, all workers increase their productivity after training but the returns increase uncertainty as time goes on. We suppose that the returns are high when firms succeed in training, but that the returns are low when firms fail in training. Some firms yield high returns on training but others yield low returns. Thus, we denote a firm that yields high returns on training with high probability as firm H and a firm that yields high returns with low probability as firm L. The returns at the end of the period are uncertain at the beginning of the period and we treat this with a probability variable.

Firm-specific training increases the need for employees to concentrate on their jobs as well as their value of marginal product.[1] Therefore, the workers' wage that yields high returns on training with high probability is larger than that yielding low returns with low probability. We denote by W_H the wage of workers of firm H and denote by W_L $(W_H>W_L)$ the wage of workers of firm L. We denote by $t_H(t_L)$ the firm-specific training cost per worker of firm $H(L)$ and denote by $R_H(R_L)$ the number of workers of firm $H(L)$. Then, the inverse labor supply function of the worker who distinguishes between high and low returns on training is as follows.

$$w_i=a(t_i)+bR_i \qquad (i=H,\ L) \tag{8}$$

We denote by s_i $(i=H,\ L)$ the rate of increase of productivity in the "success" state. We denote the same for f_i $(i=H,\ L)$ in the "failure" state. Firms obtain high returns on training with probability μ_i (s_i) $(i=H,\ L)$ and fail to obtain high returns with probability $1-\mu_i$ (f_i) $(i=H,\ L)$. For simplicity, we suppose that firms are identical in all respects other than their returns on training investment.

We reformulate the expected profit function with uncertainty of training effects, $E\Pi$ as follows,

$$E\Pi=\mu_i(1+s_i)y(R_i)p+(1-\mu_i)(1+f_i)y(R_i)p-w_iR_i-t_iR_i \tag{9}$$

Substituting the inverse labor supply function (8) into Eq.(9) yields

$$E\Pi=\mu_i(1+s_i)y(R_i)p+(1-\mu_i)(1+f_i)y(R_i)p[a(t_i)+bR_i]R_i-t_iR_i \tag{10}$$

We assume that firms H and L employ workers to maximize their profit. Let R_i^* denote the equilibrium numbers of workers.

We suppose that firms are identical in all respects other than their returns on training investment and the probability with which firms obtain high returns on training. That is, both firms H and L produce the product with the same quality and price. The wages of the workers of firm H are different from those of firm L when the worker distinguishes between high and low returns on training.

We assume that workers are homogeneous in all respects other than the need to concentrate on their jobs. Workers that receive firm-specific training in firm H increase their productivity with high probability, but workers in firm L increase their productivity with low probability. Firm-specific training increases the need to concentrate on their jobs. Therefore, the wage of workers in firms that yield high returns on training with high probability is larger than that of firms that yield low returns with low probability. We assume there are workers H and workers L in the labor market. Workers H prefer working at firm H and workers L prefer working at firm L. In the case of perfect information, workers H work at firm H and workers L work at firm L.

6. Long Period Employment

In this section, a model consisting of two consecutive periods, specified by three points in time, is proposed. At the start of the first period, firms employ workers. Workers are assumed to be employed for a long period and to be protected by employment legislation. The wage of workers is a function of firm-specific training and the need for workers to concentrate on their jobs. We assume that the prices of the products of the first and second periods are given. At the start of the first period, each firm is assumed to employ workers to maximize its expected long period profit.

Next, we suppose that skilled technical personnel generate innovation. We denote by g the probability that the products of firms H and L are in fashion in the second period, and denote by $1-g$ the probability that the products of firms H and L are out of fashion in the second period. If the products are in fashion in the second period, the price of products rises. If products are out of fashion in the second period, the price of products decreases. We denote by p_G the price of the products when they are in fashion in the second period, and denote by $p_B(p_G > p_B)$ the price of the products when the products are out of fashion in the second period. At the beginning of the first period, the price in the second period is uncertain and we treat it with a probability variable.

For simplicity, we assume that the productivity of workers is homogeneous at the beginning of the first period. We denote by R the number of regular workers and denote by y the products of workers. We assume that the products are an increasing concave function of the number of workers. That is, $y=y(R)$, $dy/dR>0$, $d^2y/dR^2<0$. Workers are assumed to receive firm-specific employee training and increase their productivity. Employees who have worked at the same company for a long period have higher productivity than employees who have worked for a short period.

We assume that the firm-specific training cost per worker is constant and we denote t as firm-specific training cost per worker. We suppose that the returns on training in the second period are high when firms succeed in training, but that the returns are low when firms fail in training. Some firms yield high returns on training but others yield low returns. Thus, we denote a firm that yields high returns on training with high probability as firm H and a firm that yields high returns with low probability as firm L. The returns at the end of the first period and the second period are uncertain at the beginning of the first period and we treat these with probability variables. We suppose that human resource development generates business innovation, which in turns brings about cost reduction and increased sales amount. That is, returns on training are assumed to include cost cutting and increased sales amount. If firms yield high returns on training, they can maintain competitiveness when the products are in fashion in the second period. We denote by s_i^1 the rate of increase of productivity when firms yield high returns on training in the first period. We denote the same for f_i^1 when firms yield low returns on training in the first period. Firms obtain high returns on training with probability μ_i (s_i^1) and fail to obtain high returns with probability $1-\mu_i$ (f_i^1). For simplicity, we suppose that firms are identical in all respects other than their returns on training investment. We denote by s_i^2 the rate of increase of productivity when firms yield high returns on training in the second period. We denote the same for f_i^2 when firms yield low returns on training in the second period. Employees who have workers at the same company for a long period have higher productivity than employees who have worked for a short period. Therefore, returns on training in the second period are higher than returns in the first period under a relatively stable economic environment. That is, $s_i^2 > s_i^1$, $f_i^2 > f_i^1$. We assume that firms obtain high returns on training with the same probability μ_i as the first period and obtain low returns with the same probability $1-\mu_i$ as the first period.

Workers are assumed to be employed from the beginning of the first period to the end of the second period. In addition, workers are assumed to be employed so as to maximize their expected long period profit at the start of the first period. Let R_i $(i=H, L)$ denote the number of long-term workers.

We suppose that sales amount increases (decreases) and returns on training investment increase (decrease) when the products are in (out of) fashion in the second period. Let $s_i^{MG}(f_i^{MG})$ denote high (low) returns in the second period when the products are in fashion in the second period and $s_i^{MB}(f_i^{MB})$ $(s_i^{MG} > s_i^{MB}$, $f_i^{MG} > f_i^{MB})$ denote high (low) returns in the second period when the products are out of fashion. The wage of workers is a function of firm-specific training and the need for workers to concentrate on their jobs. In addition, employees who are workers at the same company for a long period have higher productivity than employees who have worked at the company for a short period. Therefore, the wage of workers in the second period is higher than the wage of regular workers in the first period. Let w_i^{MP1} denote the wage of workers in the first period and w_i^{MP2} $(w_i^{MP1} > w_i^{MP2})$ the wage of workers in the second period.

The expected profits in the second period that firm i $(i=H, L)$ earns when the products are in fashion in the second period are as follows.

$$\begin{aligned}\Pi_i^{MG} = \mu_i[(1+s_i^{MG})y(R_i)p_G - w_i^{MP2}(R)R_i - t_i^{MP}R_i] \\ +(1-\mu_i)[(1+f_i^{MG})y(R_i)p_G - w_i^{MP2}(R)R_i - t_i^{MP}R_i]\end{aligned} \quad (11)$$

The expected profits in the second period that firm i $(i=H, L)$ faces when the products are out of fashion in the second period are as follows.

$$\begin{aligned}\Pi_i^{MB} = \mu_i[(1+s_i^{MB})y(R_i)p_B - w_i^{MP2}(R)R_i - t_i^{MP}R_i] \\ +(1-\mu_i)[(1+f_i^{MB})y(R_i)p_B - w_i^{MP2}(R)R_i - t_i^{MP}R_i]\end{aligned} \quad (12)$$

We assume that the expected profit in the second period is larger than that in the first period when firms can maintain competitiveness. In addition, we assume that the expected profit in the second period is smaller than that in the first period when firms fail to maintain competitiveness.

Each firm is assumed to employ workers so as to maximize its expected profit for a long period.

We denote by R_i the number of workers in the first period. We define p as the price of the product in the first period. Then, the profit function to involve these training effects in the first period is specified as follows.

$$\begin{aligned}\Pi_i^{M1} = \mu_i[(1+s_i^1)y(R_i)p - w_i^{M1}(R)R_i - t_i^{MP}R_i] \\ +(1-\mu_i)[(1+f_i^1)y(R_i)p - w_i^{M1}(R)R_i - t_i^{MP}R_i]\end{aligned} \quad (13)$$

We assume that the expected profit in the second period is larger than that in the first period when firms can maintain competitiveness. Therefore, $\Pi_i^{MG} > \Pi_i^{M1} > \Pi_i^{MB}$.

Again, for simplicity, we express the price of production in the expectation value. Let $MP_i^{GS}(R)$ $(MP_i^{GF}(R))$ denote the profit function in the "success" state ("failure" state) when the products are in fashion in the second period and $MP_i^{BS}(R)(MP_i^{BF}(R))$ the profit function in the "success" state ("failure" state) when the products go out of fashion in the second period. Then, the profit function for long period employment is specified as follows when the products are in fashion in the second period.

$$MP_i^{GS}(R) = \Pi_i^{M1} + (1+s_i^{MG})y(R_i)p - w_i^{M2}(R)R_i - t_i^{MP}R_i \quad (14)$$

$$MP_i^{GF}(R) = \prod_i^{M1} + (1 + f_i^{MG}) y(R_i) p - w_i^{M2}(R) R_i - t_i^{MP} R_i \tag{15}$$

The profit function for long period employment is specified as follows when the products go out of fashion in the second period.

$$MP_i^{BS}(R) = \prod_i^{M1} + (1 + s_i^{MB}) y(R_i) p - w_i^{M2}(R) R_i - t_i^{MP} R_i \tag{16}$$

$$MP_i^{BF}(R) = \prod_i^{M1} + (1 + f_i^{MB}) y(R_i) p - w_i^{M2}(R) R_i - t_i^{MP} R_i \tag{17}$$

We assume that firms employ workers to maximize their expected profit for the long period. The maximization problems that each firm faces at the start of the first period are as follows.

$$\begin{aligned} \underset{R,t}{Max}.\prod_i^{MP} = g\{&\mu_i MP_i^{GS}(R) + (1-\mu_i) MP_i^{GF}(R)\} \\ &+ (1-g)\{\mu_i MP_i^{BS}(R) + (1-\mu_i) MP_i^{BF}(R)\} \end{aligned} \tag{18}$$

7. Short Period Employment

As described in Section 3, firm-specific training for workers increases their labor productivity and skilled technical personnel generate innovation. The environment facing firms is changing and business innovations are required to maintain competitiveness. Employees who have worked at the same company for a long period have higher productivity than employees who have worked for a short period. Workers who are employed for the long term are protected by employment legislation. Therefore, it is difficult for firms to adjust employment when the products go out of fashion and the risk of bankruptcy increases. If firms shorten the employment period of workers, the risk of bankruptcy decreases but the returns on training decrease and the risk of obsolescence increases.

In this section, workers are assumed to be employed for a short period. That is, workers are employed in every period. We assume that firms can increase workers if the economy improves in the second period. Workers are assumed to receive firm-specific employee training and increase their productivity. We assume that the returns on training for the short-term employment workers are lower than those of the long-term regular employment workers. For simplicity, we suppose that repeating the training for the short-term employment workers yields the same returns in each period. That is, the rate of increase of productivity is the same as that in the second period. The wage of workers is a function of firm-specific training and the need for workers to concentrate on their jobs. Then, the wage of workers in the second period is the same as that in the first period. We assume that firms obtain high returns on training with probability μ_i, but firms do not obtain high returns with probability $1-\mu_i$. In addition, we suppose that the rate of increase of productivity of short-term employment is the same as that in the first period of the long-term employment model, s_i^1. Furthermore, we assume that the returns on investment are given for firms and that firms are identical in all respects other than returns on investment.

At the beginning of the first period, each firm is assumed to employ workers to maximize its expected long-term profit. Firms provide firm-specific training to workers. The employment of all workers is terminated at the end of the first period. At the beginning of the second period, firms employ workers again after knowing economic conditions. We denote by R_i the number of workers in the first period.

We suppose that the price is high (low) when the products are in fashion (go out of fashion) in the second period. Let p_G denote the price when the products are in fashion in the second period and p_B ($p_G > p_B$) the price when the products are out of fashion. In addition, we assume that the wage of workers is the same as the wage of workers in long-term employment in the first period from the assumption that the rate of increase of productivity of short-term employment is the same as that in the first period of the long-term employment model. We denote by w_i^{SP} the wage of workers. If the products go out of fashion in the second period, firms terminate workers and firms employ workers after knowing economic conditions.

The expected profits of each firm when the products are in fashion in the second period are as follows.

$$\prod_i^{SP} = \mu_i[(1+s_i^1)y(R_i)p_G - w_i^{SP}(R)R_i - t_i^{SP}R_i] \\ + (1-\mu_i)[(1+f_i^1)y(R_i)p_G - w_i^{SP}(R)R_i - t_i^{SP}R_i] \quad (19)$$

Let R_i^G denote the sub-game equilibrium number of workers when the products are in fashion in the second period. From the first-order condition,

$$[\mu_i(1+s_i^1)+(1-\mu_i)(1+f_i^1)]y'(R_i^G)p_G = w_i^{SP}(R)+t_i^{SP}.$$

The sub-game equilibrium number of workers R_i^G increases when the products are in fashion in the second period. This is because the price rises when the products are in fashion in the second period.

The expected profits each firm faces when the products go out of fashion in the second period are as follows.

$$\prod_i^{SP2} = \mu_i[(1+s_i^1)y(R_i)p_B - w_i^{SP}(R)R_i - t_i^{SP}R_i] \\ + (1-\mu_i)[(1+f_i^1)y(R_i)p_B - w_i^{SP}(R)R_i - t_i^{SP}R_i] \quad (20)$$

Let R_i^B denote the sub-game equilibrium number of workers when the products go out of fashion in the second period. From the first-order condition,

$$[\mu_i(1+s_i^1)+(1-\mu_i)(1+f_i^1)]y'(R_i^B)p_B - w_i^{SP}(R)+t_i^{SP}.$$

The sub-game equilibrium number of regular workers R_i^B decreases when the products go out of fashion in the second period. This is because the price falls when the products go out of fashion in the second period.

In the first step, each firm is assumed to regard the equilibrium number of workers in the second period as given and to employ workers so as to maximize its expected profit for the two periods.

We denote by R_i the number of workers. We define p as the price of the product in the first period, w_i^{SP} as the wages of the workers. Then, the profit function to reflect these training effects in the first period, $\prod_i^{S1}$, is specified as follows.

$$\prod_i^{S1} = \mu_i[(1+s_i^1)y(R_i)p - w_i^{SP}(R)R_i - t_i^{SP}R_i] \\ + (1-\mu_i)[(1+f_i^1)y(R_i)p - w_i^{SP}(R)R_i - t_i^{SP}R_i] \quad (21)$$

Let $SP_i^{GS}(R)$ $(SP_i^{GF}(R))$ denote the profit function in the "success" state ("failure" state) when the products are in fashion in the second period and $SP_i^{BS}(R)$ $(SP_i^{BF}(R))$ the profit function in the "success" state ("failure" state) when the products go out of fashion in the second period. Then, the profit function for short period employment is specified as follows when the products are in fashion in the second period.

$$SP_i^{GS}(R) = \prod_i^{S1} + (1+s_i)y(R_i^G)p_G - w_i^{SP}(R)R_i^G - t_i^{SP}(R_i^G) \quad (22)$$

$$SP_i^{GF}(R) = \prod_i^{S1} + (1+f_i)y(R_i^G)p_G - w_i^{SP}(R)R_i^G - t_i^{SP}(R_i^G) \quad (23)$$

The profit function for short period employment is specified as follows when the products go out of fashion in the second period.

$$SP_i^{BS}(R) = \prod_i^{S1} + (1+s_i)y(R_i^B)p_B - w_i^{SP}(R)R_i^G - t_i^{SP}(R_i^B) \quad (24)$$

$$SP_i^{BF}(R) = \prod_i^{S1} + (1+f_i)y(R_i^B)p_B - w_i^{SP}(R)R_i^B - t_i^{SP}(R_i^B) \quad (25)$$

We assume that firms employ workers and give firm-specific training to maximize their expected profit for the two periods. The maximization problem that each firm faces at the start of the first period is as follows.

$$\underset{R,t}{Max.}\prod_i^{SP}=g\{\mu_i SP_i^{GS}(R)+(1-\mu_i)SP_i^{GF}(R)\}$$
$$+(1-g)\{\mu_i SP_i^{BS}(R)+(1-\mu_i)SP_i^{BF}(R)\} \quad (26)$$

8. Employment Period and Innovation

Employees who have worked at the same company for long periods have higher productivity than regular employees who have worked for short periods. Regular workers who are employed for the long term are protected by employment legislation. Therefore, it is difficult for firms to adjust employment when the economy worsens. If firms shorten the employment period of workers, the risk of bankruptcy decreases but their returns on training decrease. The fall in returns means missing an opportunity to innovate. If a firm does not carry out human resource development with a long-term perspective, it cannot maintain competitiveness. That is, the risk of obsolescence increases. In addition, the shortening of the employment period of workers increases the risk of unemployment for workers. In this section, we consider that firms with large (small) returns on their investments employ workers for a long (short) period.

If a firm employs long-term workers, its returns on training for the long period are larger than those for the short period. From (18) and (26), if

$$MP_i^{GS}(R\,;\,t_i^{MP})>SP_i^{GS}(R\,;\,t_i^{SP}),\ MP_i^{GF}(R\,;\,t_i^{MP})>SP_i^{GF}(R\,;\,t_i^{SP}),$$
$$MP_i^{BS}(R\,;\,t_i^{MP})>SP_i^{BS}(R\,;\,t_i^{SP}),\ MP_i^{BF}(R\,;\,t_i^{MP})>SP_i^{BF}(R\,;\,t_i^{SP}),$$

then $\prod_i^{MP}>\prod_i^{SP}$. That is, firms with high returns on training employ long-term workers if returns on training for the long period are large ($s_H>s_L$, $f_H>f_L$). Firms with high returns on training employ long-term workers when there is high probability that firms obtain high returns on training ($\mu_H>\mu_L$). Firm-specific training increases the need for workers to concentrate on their jobs as well as their value of marginal product. That is, firm-specific training induces an upward shift of the labor supply function and increases the wage. From (5), returns on training increase with training cost and training cost for the long period is higher than that for the short period. Therefore, firms with high returns on training employ short-term workers when the wage of short-term workers is sufficiently low ($w_H^{MP}>w_H^{SP}$, $w_H^{MP}>w_L^{SP}$) or when returns on training for the long period are sufficiently large.

It is desirable for firms with small returns to employ short-term workers. On the contrary, firms with large returns might employ short-term workers if the risk of employment adjustment is larger than the returns on training. Therefore, firms with large returns employ long-term workers when profit from long-term employment is larger than profit from short-term employment.

When firms obtain small returns on their training investments, the workers of these firms do not need complex skills. At these firms, lengthening the employment term slightly increases the returns on their investments and increases employment adjustment risk. Therefore, it is desirable for firms with small returns to employ short-term workers. On the contrary, it is desirable for firms with large returns to employ long-term workers.

9. Conclusion

The proportion of youth temporary employment to regular employment is increasing in OECD countries because employment protection legislation for regular employment has been retained but temporary employment has been deregulated. Japan entered a recession in the 1990 s and the protection of older regular employees has restrained youth employment. It is natural that firms adjust to business fluctuations but legislation protecting regular workers has made it difficult to adjust employment. In particular, the employment term under the lifetime employment system in Japan is longer than business cycle phases. Therefore, employment of many regular workers has increased the risk that firms' management will deteriorate. On the other hand, firm-specific training for regular workers has increased labor productivity and generated innovation. The environment facing firms is changing and business innovation is required to maintain competitiveness. That is, firms have to compare the risk of employment adjustments with returns on their investments. When returns on training for the long period are large, firms employ long-term regular workers. When firms obtain large returns on their training investments, firms that increase employment of long-term regular workers increase their profit and productivity. At these firms, lengthening the employment term slightly increases the returns on firms' investments and increases employment adjustment risk. Therefore, we consider that firms that yield large returns on investment employ regular workers for a long period but firms that yield small returns on investment employ regular workers for a short period. In the United States, it is desirable that firms employ regular workers for a short period because firms provides little firm-specific training to regular workers and many workers acquire skills before obtaining employment. However, firms cannot maintain competitiveness if they do not carry out human resource development with a long-term perspective. In this study, we assume that the abilities of all workers are the same before training and only firm-specific training increases labor productivity and generates various innovations. However, in fact, different workers have different skills. We leave the investigation of how different skills affect returns on investment for future research.

References

Becker, Gary S. 1962. Investment in human capital: a theoretical analysis. *Journal of Political Economy* 70: 9 – 49.

Blanchard, Olivier, and Augustin Landier. 2002. The perverse effects of partial labour market reform: fixed-term contracts in France. *The Economic Journal* 112: 214 – 44.

Bouillon, Marvin L., B. Michael Doran, and Peter F. Orazem. 1996. Human capital investment effects on firm returns. *Journal of Applied Business Research* 12, no. 1: 30 – 41.

Cooper, Russell, and Beth Hayes. 1987. Multi-period insurance contracts. *International Journal of Industrial Organization* 5: 211 – 31.

Doeringer, Peter B., and Michael L. Piore. 1971. *Internal labor markets and manpower analysis.* Lexington, Mass: Heath Company.

Flamholtz, Eric G. 1985. *Human resource accounting.* 2 nd ed. Dordrecht: Kluwer Academic.Publishers.

Hashimoto, Masanori. 1981. Firm-specific human capital as a shared investment. *American Economic Review* 71, no. 3: 475 – 82.

Nakamura, Takahide. 1975. *Nihon keizai no shinro* (Direction of the Japanese economy). Tokyo: University of Tokyo Press.

OECD. 2004. *Employment outlook*, 2004, Chapter 2.

Piore, Michael J. 1970. The dual labor market: theory and applications. In *The state and the poor*, ed. Richard E. Barringer and Samuel H. Beer. Cambridge, Mass: Winthrop.

Umemura, Soji. 1971. *Rodo-ryoku no kozo to koyo-mondai* (Structure of labor force and employment issues).Tokyo: Iwanami Shoten.

1 The worker with assembly lines operating at high speed feels greater fatigue than does the worker with low speed lines.

Firm-Specific Human Capital and Employment Period

AOBA Nobuko*

(Keywords: firm-specific human capital, employment period)

Lifetime employment and employee training within large enterprises are distinctive features of the Japanese employment system. Young people mainly have been hired by large enterprises immediately after graduation, and their career paths are based on Japanese employment practices. We consider whether firm-specific human capital and employment period have made Japanese companies grow. We use risk of obsolescence to analyze the relationship between firm-specific training and employment period. We find that firms that yield large returns on training investment employ regular workers for long periods but firms that yield small returns on training investment employ regular workers for short periods.

*Naruto University. Nakajima 748, Naruto, Naruto-shi, Tokushima 772-8502, Japan. E-mail: aoba@naruto-u.ac.jp.