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Quit, Layoff, and Human Capital

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I. Introduction

The separation behavior - quits and layoffs - of workers has long been analyzed as an important issue in the labor economics. As in the main literature, this paper deals with the questions about why the separations occur and how they would change with other economic variables, and about whether or not the actual separation rate is efficient. The models that are close in spirit to this paper would be Hall & Lazear(1984), Hashimoto & Yu(1980), McLaughlin(1991). My model shares with these models one property that it is the rent created by human capital which causes quits and layoffs. In my model, however, the size of rent is determined by the worker's decision on human capital accumulation, whereas it is exogenously given in other models. By examining the worker's choice of human capital, this paper will first explain the two stylized facts of the separation behavior - positive correlation

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between quit and layoff across industries and negative correlation over business cycles -. It will also explore the efficiency implications of the separation behavior and human capital decision, and will evaluate the unemployment insurance system within the model.

When we introduce the worker's incentive for human capital into the model, we have to deal with the following two problems. The first problem is the relationship between human capital and separation rates. The separation rate would affect the level of human capital, because, in choosing the level of human capital, a worker has to take into account the possibility of his being separated. And, conversely, the human capital affects quit and layoff rate through the rent it create. The interactive relationship between separation and human capital yields one of the main results in this paper: quits and layoffs would be positively correlated to each other across the industries or across different characteristics of worker, although they are negatively related to each other over time.

The second problem we have to deal with is the so-called hold-up problem. As long as the worker's share is less than full, he would not have full incentive for the human capital which is sunk. This paper shows that a worker's incentive for human capital is insufficient because of the hold-up distortion, which leads to excessive separation rates. In addition to the wage rigidity pointed by Hall \& Lazear(1984), therefore, the model identifies another cause for the excessiveness of separation rate.

In examining the worker's incentive for human capital in the presence of the hold-up problem, this paper compares the two cases with each other: the case when the wage is flexible in the sense that the set by a firm reflects its idiosyncratic shock, and the case when the wage is not flexible, i.e., when the wage is rigid. It is argued that the wage rigidity could enhance the incentive for human capital on the part of workers given the existing hold-up distortion, because the incentive to reduce the layoff probability through the increase in human capital may outweigh the disincentive effect of the excessive separation due to the wage rigidity. Furthermore, this paper argues that, when the worker's share of the rent is small, the layoff rate could be lower under wage rigidity than under the wage flexibility. This result can be contrasted with Hall \& Lazear(1984), who demonstrated that the layoff rate under the wage rigidity is higher than that under the wage flexibility. The difference between the two results can be explained by the following. Although the wage flexibility guarantees the efficient layoff rate in Hall & Lazear(1984) where there is no hold-up problem, it is not the case in my model because of the insufficient human capital due to the hold-up. And, once the distortion caused by the hold-up is present, another distortion by the wage rigidity could improve the welfare.

This paper also points out the possibility of improving further the welfare in the context of the wage rigidity. Since the human capital decision by worker and the layoff decision by his employer are interdependent upon each other, an employer can find it in his interest to commit himself to the lower layoff rate when the layoff is excessive due to the wage rigidity. For example, an employer could use an experience-rated unemployment insurance system as a commitment to lower layoff rate, because the experience-rated UI would increase the layoff cost for the employer. In particular, this paper argues that the unemployment insurance system can increase the welfare by reducing the layoff rate and by increasing the incentive for human capital, provided that the system is experience-rated. This result can be contrasted with Topel(1983), who argues that the unemployment insurance system which is incompletely experience-rated increases the unemployment incidence. One related result that deserves to be mentioned is that, despite the wage rigidity and the hold-up distortion, an experience-rated unemployment insurance system enable us to achieve the first-best efficiency in the human capital and separation decisions under certain circumstances.

The following section introduces a simple model that describes the sequential decision makings on human capital, quit, and layoff by workers and employers. Section 3 collects comparative static results to show the relationships between quits and layoffs for the time series and the cross-sectional data. Some efficiency implications for the workers' separation behavior are explored in Section 4, and an experience-rated UI system is analyzed as a means of commitment to the lower layoff rate for employers in Section 5. Finally, Section 6 presents some concluding remarks, and suggests a couple of empirically testable hypothesis that can be derived from our theoretical model.

Ⅱ. Model

Consider a following simple 2-period model. In period 0 an employer hires a worker, and a worker accumulates his own human capital K. A worker incurs a certain costs in choosing K in the following way.

$$C = C(K, A), \quad \text{(1)}$$

where A represents a worker's preemployment ability that may be determined by education or his innate ability, and

$$C_K > 0, \quad C_A < 0, \quad C_{KK} > 0, \quad C_{KA} < 0. \quad \text{(2)}$$

The human capital a worker accumulated can enhance his productivity in period 1. It is assumed that a fraction a of a worker's human capital K is general within the industry and the rest $(1-a)$ of K is firm-specific. The productivity $P_{ij}(K)$ in period 1 of a worker with K in firm i in industry j would depend upon shocks, both general θ and idiosyncratic s_{ij}, as well as upon his human capital level K and upon the profitability b_{ij} of the firm i in the industry j. We will assume that

$$P_{ij}(K, \theta) = \theta f(b_{ij}, K) + s_{ij}, \quad \text{(3)}$$

where $\theta(>0)$ is a random variable distributed with mean 1, and s_{ij} is uniformly distributed over the interval $[-\frac{1}{2h_j}, \frac{1}{2h_j}]$ with the distribution function $H_j(.)$. b_{ij} (>0), which is a common knowledge from the beginning, is distributed with mean m_j.. It is assumed that the general shock θ for period 1 becomes publicly known at the end of period 0, and that the idiosyncratic shock s_{ij} is privately known to the firm at the beginning of period 1. Here we will for simplicity assume that

$$\begin{aligned} f(b_{ij}, K) &= b_{ij} + K \\ &= R_{ij}(K) + aK, \end{aligned}$$

where $R_{ij}(K) \equiv b_{ij} + (1-a)K$, which will turn out to be the rent to be divided between a worker and the employer.

At the end of period 0, the firms in each industry create new jobs for each level of human capital, and randomly makes offers for the existing workers in the same industry to fill the new vacancies. Let β be a proportion of the new jobs to the total number of the existing jobs for each level of human capital in an industry. Then, a worker can receive an outside offer from a new job in the same industry with probability β at the end of period 0. Since β would depend upon the parameter values that change over time, we can reasonably assume that this fraction $\beta(\theta)$ increases in θ. In making a quit decision, a worker will compare the expected payoff in period 1 for the current job with the expected payoff of the outside offer. The expected payoff will be determined by the expected wage and the probability of being laid off in period 1.

The decisions on wage and layoff are made at the beginning of period 1 when the idiosyncratic shock s_{ij} is realized. Note that a worker makes his quit decision prior to his employer's layoff decision in this model. This reflects the fact that a worker's quit decision depends upon his employer's layoff decision, although the converse is not true. In other words, a worker may have to care about his employment security as well as his wage when comparing the current job with the outside offer, whereas employer would not care about his worker's quit probability when making the layoff decision because the only thing that matters for the employer is the worker's productivity relative to his wage.

The wage for a worker is determined by a Nash bargaining solution between him and his employer in this model. It is assumed that at the beginning of period 1, a worker has no chance to be hired by another employer, but that he can be self-employed and paid as much as θaK on the average. Thus, the values of the outside opportunity for an employer ij and a worker at the beginning of period 1 would be zero and θaK, respectively. This implies that $\theta R_{ij}(K)$ will be the expected rent that is to be divided between the firm ij and a worker. Note that the wage cannot be conditioned upon the idiosyncratic shock s_{ij} , which is not observable to the worker. Thus the wage for the worker will be set to be a certain fraction α of the expected rent $\theta R_{ij}(K)$ plus the value of his outside opportunity θaK

$$w_{ij}(K, \theta) = \theta\{\alpha R_{ij}(K) + aK\}$$

Then, the profit $\pi_{ij}(K, \theta)$ will be

$$\pi_{ij}(K, \theta) = \theta R_{ij}(K)(1-\alpha) + s_{ij}. \qquad (4)$$

Thus a firm ij will layoff a worker with K if

$$\pi_{ij}(K, \theta) < 0$$

or

$$s_{ij} < \widehat{s_{ij}}(K, \theta)$$

where

$$\widehat{s_{ij}}(K, \theta) = -(1-\alpha)\theta R_{ij}(K). \qquad (5)$$

Thus the layoff probability $F_{ij}(K, \theta)$ will be

$$\begin{aligned} F_{ij}(K, \theta) &= H_j(\widehat{s_{ij}}(K, \theta)) \\ &= H_j(-(1-\alpha)\theta R_{ij}(K)), \end{aligned} \qquad (6)$$

where $H_j(.)$ is the distribution function of s_{ij}.

Consider next the quit decision for a worker. The expected payoff for a worker with K of staying with his current employer ij, $W_{ij}(K, \theta)$ will be

$$W_{ij}(K, \theta) = \theta\{(1-H_j(\widehat{s_{ij}}(K, \theta))\alpha R_{ij}(K) + aK\}. \qquad (7)$$

We can see from (7) that $W_{ij}(K, \theta)$ is increasing in $\theta R_{ij}(K)$. Since an outside offer comes from another firm i' in the same industry j, the expected rent $\theta R_{i'j}(K)$ that the worker with K can generate in the firm i' will be

$$\theta R_{i'j}(aK) = \theta b_{i'j}.$$

Note that once a worker moves to another firm, his human capital will be reduced to aK. The wage $w_{i'j}(K, \theta)$ set by the firm i' will be $\theta\{ab_{i'j} + aK\}$. Thus the value of the outside offer will be

$$W_{i'j}(K, \theta) = \theta\{(1-H_j(\widehat{s_{i'j}}(K, \theta))aR_{i'j}(K) + aK\},$$

which varies with $b_{i'j}$. Then, the probability that a worker quits his current employer once an outside offer is given will be

$$\begin{aligned}\Pr(W_{i'j}(K, \theta) > W_{ij}(K, \theta)) &= \Pr(b_{i'j} > R_{ij}(K)) \\ &= \Pr(b_{i'j} > b_{ij} + (1-a)K) \\ &= 1 - G(\omega_{ij} + (1-a)K),\end{aligned}$$

where $\omega_{ij} \equiv b_{ij} - m_j$, and $G(.)$ is the distribution function of the random variable $\omega_{i'j}$ ($\equiv b_{i'j} - m_j$). Since a worker can receive an outside offer with probability $\beta(\theta)$, therefore, the probability $Q_{ij}(K, \theta)$ that he quits the firm i in an industry j will be

$$Q_{ij}(K, \theta) = \beta(\theta)\{1 - G(\omega_{ij} + (1-a)K)\}. \qquad (8)$$

Finally, we will look at the worker's problem of choosing his human capital K. The payoff an worker expects from choosing K, $V_{ij}(K)$, will be

$$V_{ij}(K) = E_\theta[\{1 - Q_{ij}(K, \theta)\}W_{ij}(K, \theta) + \beta(\theta)\int_{(\ )} W_{i'j}(K, \theta)dG]$$

$$= E_\theta[\{1 - \beta(\theta)\{1-G(\omega_{ij}+(1-a)K)\}\}W_{ij}(K,\theta) \cdots\cdots (9)$$
$$+\beta(\theta)\int_{\omega_{ij}} W_{i'j}(K,\theta)dG],$$

where $W_{i'j}(K,\theta) = \theta\{(1-H_j(\widehat{s_{ij}}(K,\theta))\alpha(\omega_{ij}+m_j)+aK\}$. Thus a worker will choose K in the following way:

$$\underset{K}{Max} \quad V_{ij}(K) - C(K,A)$$

Then the optimal K^* will then satisfy the following condition:

$$\frac{\partial V_{ij}}{\partial K}(K^*) - \frac{\partial C}{\partial K}(K^*,A) = 0, \cdots\cdots (10)$$

where

$$\frac{\partial V_{ij}}{\partial K} = a + E_\theta\{1-\beta(\theta)+\beta(\theta)G(\omega_{ij}+(1-a)K)\}$$
$$(1-a)\alpha(1-H_j(\widehat{s_{ij}})-h_jR_{ij}\frac{\partial \widehat{s_{ij}}}{\partial K}) \cdots\cdots (11)$$
$$= a + E_\theta\{1-\beta(\theta)+\beta(\theta)G(\omega_{ij}+(1-a)K)\}$$
$$(1-a)\alpha\{1-H_j(-(1-a)R_{ij})+h_j(1-a)R_{ij}\},$$

and the second-order condition is assumed to be satisfied. If we take a look at (11), α has the two conflicting effects upon the worker's choice of human capital. First, α can increase the incentive for human capital because the return to human capital will increase with the worker's share α. Second, α can decrease the human capital incentive because the chance of being laid off will increase with the worker's share α. We will defer the further discussion until section 5, where we deal with the efficiency implications of the choice of human capital.

Now we can establish the following proposition.

Proposition 1

(i) $\frac{\partial K^*}{\partial A} > 0,$

(ii) $\frac{\partial K^*}{\partial m_j} > 0,$

(iii) $\frac{\partial K^*}{\partial h_j} > 0.$

Proof

(i) It is clear from the fact that $C_{KA} < 0$.

(ii) Setting ω_{ij} to be constant, $G(.)$ would not change and $db_{ij} = dm_j$. Since

$$\frac{\partial^2 V_{ij}}{\partial K \partial m_j} = 2E_\theta\{1-\beta(\theta)+\beta(\theta)G(\omega_{ij}+(1-a)K)\}(1-a)\alpha(1-\alpha)h_j > 0,$$

$$\frac{\partial K^*}{\partial m_j} > 0.$$

(iii) $$\frac{\partial^2 V_{ij}}{\partial K \partial h_j} = 2E_\theta\{1-\beta(\theta)+\beta(\theta)G(\omega_{ij}+(1-a)K)\}(1-a)\alpha(1-\alpha)R_{ij} > 0.$$

The above proposition implies that a worker of higher education or a worker in an industry of higher profitability chooses larger K. It also implies that a worker in an industry of more variable profitability (or of lower h_j) would choose lower K because of the higher separation rate.

We have thus far described how human capital, layoff and quit rates are determined in this model. These variables are set by $\widehat{s_{ij}}$, K^* (determined by (5), (10)) and by (6) and (8). What should be emphasized here is that the choice of K is related to the layoff decision $\widehat{s_{ij}}$ ((6)) and with the quit decision Q_{ij} ((8)). In other words, lower $\widehat{s_{ij}}$ (or lower Q_{ij}) induces higher K^*, and higher K^* leads to lower $\widehat{s_{ij}}$ (or lower Q_{ij}). As we will see later, this relationship between human capital decision and separation behavior is responsible for the positive correlation between quit and layoff rate that we can observe in the cross-sectional industry data.

Ⅲ. Comparative Statics

Here we will analyze how the layoff and quit rate, which are uniquely determined in the model, change as some important exogenous variables change. First we can establish the following proposition.

Proposition 2

$$\frac{\partial F_{ij}}{\partial A} < 0, \qquad \frac{\partial Q_{ij}}{\partial A} < 0$$

$$\frac{\partial F_{ij}}{\partial m_{ij}} < 0, \qquad \frac{\partial Q_{ij}}{\partial m_j} < 0$$

$$\frac{\partial F_{ij}}{\partial h_j} < 0, \qquad \frac{\partial Q_{ij}}{\partial h_j} < 0$$

Proof

Since $C_{KA} < 0$, $\frac{\partial K^*}{\partial A} > 0$ by Proposition 1. Also $\frac{\partial Q_{ij}}{\partial A} < 0$ by (8). \ Hence $\frac{\partial Q_{ij}}{\partial A} = \frac{\partial Q_{ij}}{\partial K^*}\frac{\partial K^*}{\partial A} < 0$. Also, $\frac{\partial \widehat{s_{ij}}}{\partial A} = -(1-a)\frac{\partial K^*}{\partial A} < 0$ from (5). Thus $\frac{\partial F_{ij}}{\partial A} < 0$ by (6). \ Setting ω_{ij} to be constant, we have $db_{ij} = dm_j$, so that $\frac{\partial K^*}{\partial m_j} > 0$ by Proposition 1. Thus $\frac{\partial K^*}{\partial h_j} < 0$ by (8). Also $\frac{\partial F_{ij}}{\partial m_j} = \frac{\partial F_{ij}}{\partial \widehat{s_{ij}}}\frac{\partial \widehat{s_{ij}}}{\partial R_{ij}}(1+\frac{\partial K^*}{\partial m_j}) < 0$. Since $\frac{\partial K^*}{\partial h_j} < 0$ by Proposition 1, $\frac{\partial Q_{ij}}{\partial h_j} < 0$ by (8). Finally, $\frac{\partial F_{ij}}{\partial h_j} = \frac{\partial F_{ij}}{\widehat{s_{ij}}}(\frac{\partial \widehat{s_{ij}}}{\partial h_j} + \frac{\partial \widehat{s_{ij}}}{\partial R_{ij}}\frac{\partial K^*}{\partial h_j}) < 0$.

The above proposition demonstrates how the quit and layoff rates differ by education and by industry. It implies that both quit and layoff rates are lower for the workers of higher education and for the more profitable or for the less variable industries. The reason is following. The workers of higher education would choose higher human capital because of the lower cost for them, which induces lower layoff and quit rate and thereby even higher human capital, and so on. Also the employers in the more profitable or in the less variable industry will layoff his workers less often, which induces the workers to choose higher level of human capital, resulting in even lower layoff and quit rate, and so on.

We can also explain in this model how the quit and layoff rates vary over the business cycle. In figuring out the effect of θ upon the quit and layoff rates, we should note that the change in θ does neither affect the choice of K^* by worker in period 0, nor affect the probability that the current offer is beaten by an outside offer, $(1-G(\omega_{ij}+(1-a)K))$. Then, we can establish the following proposition.

Proposition 3

$$\frac{\partial F_{ij}}{\partial \theta} < 0, \qquad \frac{\partial Q_{ij}}{\partial \theta} > 0.$$

Proof

Since $\frac{\partial \widehat{s_{ij}}}{\partial \theta} < 0$ by (5) and since K^* and $G(\omega_{ij}+(1-a)K)$ do not change with θ,

$$\frac{\partial F_{ij}}{\partial \theta} = \frac{\partial F_{ij}}{\partial \widehat{s_{ij}}} \frac{\partial \widehat{s_{ij}}}{\partial \theta} < 0$$

$$\frac{\partial Q_{ij}}{\partial \theta} = \frac{\partial Q_{ij}}{\partial \beta} \frac{\partial \beta}{\partial \theta} > 0.$$

The above proposition demonstrates how quit and layoff rates change over the business fluctuations. It implies that quit rate is higher but layoff rate is lower during the good times than during the bad times. Notice from Propositions 2,3 that for a given time quit and layoff rates are positively related to each other across industries and across education levels, although for a given industry or for a given education level they are negatively related to each other over time. The latter relationship between quit and layoff rates has been empirically confirmed.

The intuitive reason for the above relationships are the following. A worker's choice of human capital is interrelated to the layoff decision by his employer and his own quit decision, which results in the positive correlation between quit and layoff rates across different education levels and across different industries. For a worker of a given education in a given industry, however, his choice of human capital does not change with economic fluctuations. During the bad times, therefore, a worker of a given level of human capital in a given industry is more likely to be laid off (than during the good times) because the value of the rent he creates, R_{ij}, sets lower. Since a worker is faced with more chance for an outside offer during the good times while the probability that the outside offer beats the current offer is the same, he will be more likely to quit during the good times than during the bad times.

Ⅳ. Efficiency Implications

In examining the efficiency implications of the human capital and separation decisions, we will further simplify the model as much as we can to highlight the essential points. Since the efficiency of the quit decision is solely related to the human capital choice in this model, here we will discard the quit behavior of the model and focus on the human capital and layoff decisions. Subtracting the quit behavior from the model, we can rewrite the payoff of choosing K and its marginal payoff as follows:

$$\begin{aligned} V_{ij}(K) &= E_\theta W_{ij}(K, \theta) \\ &= E_\theta\{(1-H_j(\widehat{s_{ij}}(K, \theta)))\alpha R_{ij}(K)+aK\} \end{aligned} \quad \cdots\cdots(12)$$

$$\frac{\partial V_{ij}}{\partial K}(K) = a + E_\theta(1-a)\alpha\theta\{1-H_j(-(1-\alpha)\theta R_{ij})+h_j(1-\alpha)\theta R_{ij}\} \quad \cdots\cdots(13)$$

Let us first characterize the efficient level K^o of human capital for a worker in firm ij and the resulting layoff rate $F^o_{ij}(\theta)$ in the model. The sum of the payoff for firm ij adopting the layoff policy $s_{ij}(K, \theta)$ and the payoff for a worker of K in period 1, $T_{ij}(K, s_{ij})$ is

$$T_{ij}(K, S_{ij}) = E_{\theta}t_{ij}(K, \theta) + aK - C(K, A), \quad\cdots\cdots(14)$$

where

$$t_{ij}(K, \theta, S_{ij}) = \int_{s_{ij}}(\theta R_{ij} + s_{ij})dH_j(s_{ij}).$$

Then we can see that the efficient human capital K and layoff policy s_{ij}, $K^o, \widetilde{s_{ij}}$, will satisfy the following:

$$\widetilde{s_{ij}}(K, \theta) = -\theta R_{ij}(K), \quad\cdots\cdots(15)$$

$$a + (1-a)E_{\theta}\theta\{1 - H_j(-\theta R^o_{ij})\} = C_K(K^o, A), \quad\cdots\cdots(16)$$

where $R^o_{ij} \equiv b_{ij} + (1-a)K^o$. And the efficient layoff rate $F^o_{ij}(\theta)$ will be

$$F^o_{ij}(\theta) = H_j(-\theta R^o_{ij}). \quad\cdots\cdots(17)$$

Comparing (17) with (6), we can say that the layoff rate determined in (6) is excessive even for a given human capital level K. This results from the fact that an employer cannot condition the wage for his worker upon the idiosyncratic shock s_{ij}.

From now on, for the purpose of simplicity, we will set $\theta = 1$ because the subsequent analysis does not depend upon specific value or distribution of θ. By (13) and (16), the conditions for K^* and K^o will then be changed as follows:

$$a + (1-a)a\{1 - H_j(-(1-a)R^*_{ij}) + h_j(1-a)R^*_{ij}\} = C_K(K^*, A) \quad\cdots\cdots(18)$$

$$a + (1-a)a\{1 - H_j(-R^o_{ij})\} = C_K(K^o, A) \quad\cdots\cdots(19)$$

where $R_{ij}^{*} = b_{ij} + (1-a)K^{*}$. Now we have the following proposition.

Proposition 4

$$K^{o} > K^{*}, \qquad \widetilde{s_{ij}}(K^{o}) < \widehat{s_{ij}}(K^{*}).$$

Proof

Let

$$X_{ij}(a) \equiv a\{1-H_j(-(1-a)R_{ij})+h_j(1-a)R_{ij}\}.$$

Then, the maximized value of $X_{ij}(a)$, $X_{ij}(a^{*})$ will be

$$X_{ij}(a^{*}) = 2a^{*}R_{ij}h_j,$$

by the first-order condition. Since $a^{*}R_{ij}h_j = H_j(-(1-a)R_{ij}) - H_j(-R_{ij})$ because s_{ij} is uniformly distributed,

$$\begin{aligned} X_{ij}(a^{*}) &= 2\{H_j(-(1-a^{*})R_{ij}) - H_j(-R_{ij})\} \\ &< 1 - 2H_j(-R_{ij}) \qquad (\because H_j(-(1-a^{*})R_{ij}) < \tfrac{1}{2}) \\ &< 1 - H_j(-R_{ij}). \end{aligned}$$

Therefore, we can see that, for any $a \in [0,1]$ and for any given R_{ij},

$$1 - H_j(-R_{ij}) > a\{1-H_j(-(1-a)R_{ij}) + h_j(1-a)R_{ij}\}.$$

Thus

$K^{o} > K^{*}$. This, together with (5) and (16), implies that $\widetilde{s_{ij}}(K^{o}) < \widehat{s_{ij}}(K^{*})$.

The above proposition implies that the actual layoff rate, $F_{ij}^{*}(= H_j(\widehat{s_{ij}}(K^{*})))$, determined in the model is excessive in the sense that $F_{ij}^{*} > F_{ij}^{o}$. There are two reasons for this excessive separation. The one is insufficient level of human capital K^{*} ($< K^{o}$) and the other is the fact that the wage cannot be conditioned upon the idiosyncratic shock. This model suggests the two factors that affect the choice of human capital by worker. First, a worker expects to have only a part of the rent created by the human capital K he chooses, which is so-called hold-up problem. Second, the worker is faced with the excessive layoff rate due to the wage rigidity, i.e., due to the fact that the wage cannot be conditioned upon the idiosyncratic shock. The latter factor has the two opposite effects upon the worker's incentive for human capital. The one is the depressing effect due to the excessive layoff rate (which is captured by the term $H_j(-(1-\alpha)R_{ij})$ in $X_{ij}(\alpha)$), and the other is positive effect which is associated with the worker's incentive to reduce the layoff probability through the increase in the human capital (which is captured by the term $h_j(1-\alpha)R_{ij}$ in $X_{ij}(\alpha)$). Taking these two effects into account, we can examine how the worker's choice of human capital will change depending upon whether he is faced with the wage rigidity or not.

Suppose for the moment that a worker is informed of his firm's idiosyncratic shock s_{ij}, so that his wage can be conditioned upon the shock, i.e., that his wage can be flexible. Under this circumstance his wage will be set to be $\alpha(R_{ij}+s_{ij})$, and his layoff probability will be $H_j(\widetilde{s_{ij}})$, where $\widetilde{s_{ij}} = -R_{ij}$. Then, the worker will choose his human capital $\widehat{K}$ such that

$$\alpha + (1-\alpha)\alpha\{1-H_j(-\widehat{R_{ij}})\} = C_K(\widehat{K}, A) \cdots\cdots (20)$$

where $\widehat{R_{ij}} \equiv b_{ij}+(1-\alpha)\widehat{K}$. We can see that (20) indicates the typical hold-up problem. In comparing the human capital and layoff decisions ($\widehat{K}$, $\widehat{F_{ij}}$) under the flexible wage with those (K^*, F^*_{ij}) under the rigid wage, we will denote each of those variables as a function of α. Then, we can establish the following proposition.

Proposition 5

If $0 < \alpha < \frac{1}{2}$, $K^*(\alpha) > \widehat{K}(\alpha)$. Also, there exists $\alpha_1(< \frac{1}{2})$ such that for $\alpha < \alpha_1$, $F^*_{ij}(\alpha) < \widehat{F_{ij}}(\alpha)$.

Proof

$K^*(0) = \hat{K}(0)$. Suppose $a > 0$. First, if we compare (20) with (18), we have

$$X_{ij}(a) > (or <) a\{1 - H_j(-R_{ij})\}$$

depending upon whether $a <$ (or $>$) $\frac{1}{2}$, which implies that $K^*(a) >$ (or $<$) $\hat{K}(a)$. If $a > \frac{1}{2}$, $F^*_{ij}(a) > \widehat{F_{ij}}(a)$ because $K^*(a) < \hat{K}(a)$. But we can prove the second part of the proposition by showing that $F^*_{ij}(0) = \widehat{F_{ij}}(0)$ and that $\frac{\partial F^*_{ij}(0)}{\partial a} > \frac{\partial \widehat{F_{ij}}(0)}{\partial a}$, which are true because $K^*(0) = \hat{K}(0)$ and because

$$\frac{\partial F^*_{ij}(0)}{\partial a} = h_j(1-a)\frac{\partial R^*_{ij}}{\partial a} > h_j(1-a)\frac{\partial \widehat{R_{ij}}}{\partial a} = \frac{\partial \widehat{F_{ij}}(0)}{\partial a}.$$

The first part of the above proposition says that, if the worker's share of the rent is less than his employer's share, the worker's incentive for human capital under the hold-up circumstance will be greater when he is faced with the wage rigidity than when faced with the wage flexibility. More importantly, the second part argues that, when the worker's share of the rent is small enough, the introduction of the wage rigidity can lower the layoff rate in the presence of the hold-up problem. This result can be compared with Hall \& Lazear, who argued that the wage rigidity causes the excessive layoff. The reason for the difference lies in the following features of the two models. Although both of the two models share the same property that a worker's human capital is important for the existence of layoff, the ways they treat the human capital in the models are different from each other. In my model I explicitly introduce the worker's incentive to choose human capital and thereby deal with the hold-up problem. In Hall & Lazear, however, the human capital level of a worker is taken as given so that there is no inefficiency of layoff resulting from the hold-up problem.

One of the interesting things that this paper shows is that, in the presence of the existing distortion (i.e., hold-up problem) for the choice of human capital, the introduction of the additional distortion (i.e., wage rigidity) could reduce the inefficiency caused by the existing distortion.

V. Welfare Implications of Unemployment Insurance System

Since the choice of K^* by a worker and the choice of $\widehat{s_{ij}}$ by an employer are interrelated to each other, the resulting K^* and $\widehat{s_{ij}}$ are smaller and higher, respectively, because the employer would not take the payoff of worker into account in setting $\widehat{s_{ij}}$ (as in (18)). If an employer can credibly make his workers certain of any $\widehat{s_{ij}}$ he sets, therefore, he will be made better off by doing so. In particular, an employer can increase his profit by committing to lower $\widehat{s_{ij}}$, if possible. We can think of the two possible ways of committing to a specific $\widehat{s_{ij}}$ available to an employer. First, an employer can form his reputation of holding his workers as long as possible by not layoffing his workers unless he has to incur large losses by holding them. Second, an employer can use the severance pay as a means of securing long-term employment, because the severance pay will increase the cost of layoffing a worker for the employer.

Here we will examine how an experience-rated unemployment insurance (UI) system, under which an employer pays taxes depending upon the amount of unemployment benefits received by the workers he has laid off, affects the choice of human capital and the separation behaviors. Suppose an employer provides a worker with unemployment benefit (UB) $z\alpha R_{ij}$ ($z \in [0, 1]$) whenever he is laid-off. Note that under a UI system an employer can transfer a part of his burden to his workers by lowering their wages. Let M be the amount of the compensation for the expected UB, which is to be substracted from the wage paid before the layoff decision. The expected profit for an employer in period 1 under this UI system will be

$$\pi_{ij}(K, \theta, z) = M + (1 - H_j(\widehat{s_{ij}}))(1 - \alpha)R_{ij} + \int_{\widehat{s_{ij}}} s dH_j + \int^{\widehat{s_{ij}}} (-z\alpha R_{ij}) dH_j, \cdots\cdots\cdots\cdots (21)$$

where M is the wage reduction as a compensation for the UB. Here we will assume for the moment that the severance pay is fully compensated, i.e., that $M = zaR_{ij}H(\widehat{s_{ij}})$. We will briefly examine later how the incomplete compensation (i.e., $M < zaR_{ij}H_j(\widehat{s_{ij}})$) affects the human capital decision and separation behavior.

Note that the compensation M for the UB depends upon the expected layoff rate, not upon the actual layoff rate, although both the expected and the actual rates are equal in equilibrium. Since an employer takes the compensation M as given in making his layoff decision on $\widehat{s_{ij}}$, his incentive for layoff would be fully affected by the UI system. The optimal $\widehat{s_{ij}}$ given z and K, $\widehat{S_{ij}}(K,z)$, will satisfy the following.

$$-\{(1-a)R_{ij}+\widehat{S_{ij}}(K,z)\} - zaR_{ij} = 0$$

or

$$\widehat{S_{ij}}(K,z) = -R_{ij}\{1-a(1-z)\}. \quad \cdots\cdots(22)$$

Note that the second-order condition is satisfied. And we can also see from (22) that

$$\widehat{S_{ij}}(K,z) < \widehat{s_{ij}}(K) \qquad \text{for } any\ z(>0) \text{ and } given\ K$$

where

$$\widehat{s_{ij}}(K) = \widehat{S_{ij}}(K,0).$$

Thus the layoff rate will be reduced for any given human capital level K under the above UI system. This indicates that the UI system could enhance the welfare in the presence of the wage rigidity so long as it increases the worker's incentive for human capital.

To figure out the effect of the UI system upon the choice of human capital K we will return for the moment to the problem of worker's decision on K. The expected utility of a worker under the UI system will be

$$V_{ij}(K,z) = \{1-H_j(\widehat{S_{ij}})\}aR_{ij} + aK. \quad \cdots\cdots(23)$$

Thus,

$$\frac{\partial V_{ij}(K,z)}{\partial K} = a + (1-a)\alpha\{1-H_j(\hat{S}_{ij})+h_j(1-\alpha(1-z))R_{ij}\}. \cdots\cdots(24)$$

Let $K(\alpha, z)$ be the optimal level of K under the UI system z:

$$\frac{\partial V_{ij}(K(\alpha,z),z)}{\partial K} = C_K(K(\alpha,z),A). \cdots\cdots(25)$$

Note that

$$\frac{\partial K(\alpha,z)}{\partial z} = -\frac{1}{T}\frac{\partial^2 V_{ij}(K(\alpha,z),z)}{\partial K \partial z},$$

where $T \equiv \frac{\partial^2 V_{ij}(K,z)}{\partial K^2} - C_{KK} < 0$ by the second-order condition. Thus, how the UI system affects the choice of human capital will depend upon the sign of $\frac{\partial^2 V_{ij}(K,z)}{\partial K \partial z}$. Differentiating (24) with respect to z, we have

$$\frac{\partial^2 V_{ij}(K(\alpha,z),z)}{\partial K \partial z} = (1-a)2\alpha^2 R_{ij}h_j \cdots\cdots(26)$$
$$> 0,$$

which implies that the experience-rated UI encourages a worker to choose higher level of human capital because it can convince him of the lower layoff probability.

Now we can establish the following proposition.

Proposition 6

In the presence of the wage rigidity, an experience-rated UI system with full compensation increases welfare as the UB z increases. In particular, the UI system can achieve the first-best efficiency by setting $z = 1$ when $\alpha = \alpha^o_{ij}$, where

$$\alpha^o_{ij} = \frac{1 - H_j(-R^o_{ij})}{1 - H_j(-R^o_{ij}) + R^o_{ij}h_j},$$

Proof

We can see from (22) and (26) that as the UB z increases, layoff rate decreases not only because of the increase in z but also because of the increase in K. This implies that an experience-rated UI system is welfare-increasing. We can see from (20) and (24) that $K^{*} = K^{o}$ and $\widehat{S_{ij}} = \widehat{s_{ij}}$, when $z = 1$ and $\alpha = \alpha_{ij}^{o}$, so that the first-best efficiency is attained.

The Proposition 6 maintains that the UI system can be welfare-increasing when the wage is rigid. When the wage is flexible, the UI system will be welfare-decreasing, because it creates the inefficiency by lowering the layoff rate below the efficient level and by reducing the human capital level further. The above proposition also argues that any inefficiency generated from the so-called hold-up problem and the wage rigidity can be completely removed by the complete UI system ($z = 1$) if the worker's share α of the rent is appropriately set. In reality, however, the UI system is far from complete. The wage compensation M may not be equal to the expected UB because of the union pressure, for example. If this is the case, as will be discussed below, the optimum level of UI may be less than complete, (i.e., $z < 1$), because then UI could reduce the incentive for human capital. Another important factor that can contribute to the incomplete UI level, which is not dealt with in this model, is that it can weaken the search incentive of a unemployed worker. This disincentive effect of UI will increases with UI level, which keeps the government from setting the UI level to be complete.

Finally, let us consider for the moment what would happen if the wage compensation is not fully made. Let $M = \rho z \alpha R_{ij} H_j(\widehat{s_{ij}})$ in general, where $\rho \in [0,1]$. Since the layoff decision would not change by the degree ρ of compensation, we still have

$$\widehat{S_{ij}}(K, z, \rho) = -R_{ij}\{1-\alpha(1-z)\}. \quad \cdots\cdots (27)$$

Then

$$W_{ij}(K, \theta, z) \equiv \{1 - H_j(\widehat{S_{ij}})(1-(1-\rho)z)\}\alpha R_{ij}.$$

$$\frac{\partial V_{ij}(K,z)}{\partial K} = a + (1-a)\alpha[1- (1-(1-\rho)z)\{H_j(\widehat{S_{ij}}) - h_j(1-\alpha(1-z))R_{ij}\}]. \qquad \cdots\cdots(28)$$

$$\frac{\partial^2 V_{ij}(K,z)}{\partial K \partial z} = (1-a)\alpha[(1-\rho)\{H_j)\widehat{S_{ij}}) - (1-\alpha(1-z))R_{ij}h_j\} +2(1-(1-\rho)z)\alpha R_{ij}h_j]. \qquad \cdots\cdots(29)$$

In general, the sign of $\frac{\partial^2 V_{ij}(K,z)}{\partial K \partial z}$ is ambiguous. This ambiguity results from the two conflicting effects of the UI upon K. The positive effect on human capital comes from the fact that an experience-rated UI can convince him of the lower layoff probability. However, the negative effect exists because, as long as the compensation is not fully made, the net expected UB, the expected UB minus the wage compensation, will increase with layoff probability, which is decreasing in human capital. If $\rho = 1$, the net expected UB will be reduced to zero, so that the negative effect of UI on human capital will disappear. We can say, therefore, that an experience-rated UI system reduces the layoff rate in general regardless of the degree of the wage compensation, although its effect on the worker's incentive for human capital might be negative if the degree of wage compensation is small.

The result about the effect of the UI on the layoff rate can be contrasted with Topel(1983), who argues that the current US UI system, which is not fully experience-rated, increases the layoff rate because the layoff is subsidized by the system. However, my model contends that, if UI system is experience-rated (even not fully), the layoff rate will decrease as long as the UI benefit is largely compensated by the wage reduction. The difference between the two models lies in the following fact. Topel(1983) focused on the firm's layoff policy, which can reflect the contractual arrangements between union and employer. It is the contractual layoff rate, not the actual incentive of an employer to layoff a worker, that Topel(1983) analyzed. In my model, however, I analyzed the incentive for an employer at the time when he has to make his decision on layoff with the relevant information. Therefore, the compensation for the benefit in terms of wage reduction would not directly affect the layoff incentive for the employer, although it could affect the layoff rate indirectly through its effect on the choice of human capital by the worker.

Topel(1983) did some empirical analysis, and confirmed his argument by showing that the unemployment incidence increases with replacement ratio. In general, however, the replacement ratio is set relatively higher for the low wage workers who are also more frequently laid-off compared to the other workers. This may be because government would like to protect those workers from the unemployment risk. This implies that high unemployment incidence could increase replacement ratio. It is not for sure whether Topel's argument can still survive after this possible causality is controlled for.

Ⅵ. Concluding Remarks

This paper analyzed quit and layoff behaviors of workers by examining their incentives for human capital, which can affect their separation behaviors through the rent it creates. First, this paper inferred from the fact that each type of separation for a worker is interrelated to his choice of human capital that two types of separation behaviors are positively correlated to each other across industries, although they are negatively correlated over time. Second, in examining the welfare implications, this paper explores how the incentive for human capital changes with wage rigidity in the context of the hold-up distortion. And we showed that given the existing hold-up distortion, the wage rigidity could improve the incentive for human capital and could lower the layoff rate when the worker's share of the rent is small. Third, by showing that the worker's incentive for human capital is insufficient under the wage rigidity and the hold-up distortion, this paper has established that the two types of separation behaviors are excessive not only because the wage cannot be conditioned upon the idiosyncratic shock but also because the level of human capital is inefficiently low.

From the interactive relationship between an employer's layoff decision and his worker's human capital decision, this paper also argued that an experience rated unemployment insurance system, which enables an employer to commit himself to lower layoff rate, could reduce the layoff rate and increase the incentive for human capital, increasing the welfare of both of the two parties. In particular, it is demonstrated that, despite the wage rigidity and the hold-up distortion, an unemployment insurance system can achieve both the efficient separation rate and the efficient level of human capital under a certain rule of sharing the rent between an employer and a worker.

Finally, as a future research project, I will suggest a few testable hypothesis that have been derived from this model. First, the model demonstrates that the quit and layoff rates for a given time and a given industry are positively correlated with each other across the workers of different education levels. Second, the experience-rated unemployment insurance system reduces the layoff rate and thereby separation rate.

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