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The Effect of Wage and Unemployment Insurance on Work Incentives: Strategis Effort Decision under Risk of Random Layoffs*

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I. Introduction

A fixed wage contract between a risk-averse worker and a risk-neutral firm is one of the results of the labor contract theory. With the fixed wage, however, the worker has an incentive to shirk because he will be paid the same regardless of his effort level.

If one's effort can be evaluated by his output level, a piece rate scheme could prevent a worker's moral hazard. However, when one's effort level is not observable as it is assumed in this paper, the firm should take the other measure to make workers exert

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themselves: The firm monitors individual work effort on the job once in a while and penalizes detected shirkers[1] by discharging them at the beginning of the next period. In this scheme, two conditions must be met in order for a threat of firing detected shirkers to be a worker discipline device.

First, workers prefer starting each period being employed. Second, a shirker must have a higher expected unemployment rate than a non-shirker. To satisfy this second condition, the monitoring literature has implicitly assumed that the followings are true at the beginning of each period.

(A1) Not-detected shirkers and non-shirkers (NDSNS) are sure to be re-employed.

(A2) Detected shirkers (DS) are discharged with probability 1.

This paper keeps (A2) but releases (A1) because NDSNS are also subject to random layoffs when the employment level is contingent upon the state of each period.[2] Such a contract with unemployment occurs when work hours are indivisible (Azariadis, 1975 and this paper) or unemployment insurance subsidies are significant (Burdett & Wright, 1989).

Since NDSNS can also be unemployed, random layoffs and discharges for shirking coexist. A random layoff is a way of varying the employment level in response to different states of the economy, and discharging shirkers is a device to enforce work discipline. This paper combines these two issues by firm's behavior described as follows.

Assume that a firm employs one hundred workers, and must lay off ten employees in a certain state. Assume also that during the last period, four workers were detected shirking. The firm's policy will be then to discharge those four DS first and randomly lay off six more workers out of the remaining 96 NDSNS to attain the optimal employment level. As a result of this policy, the following elements can be introduced into the model.

First, workers will behave strategically. Both of layoffs and discharges affect the employment level, and layoffs occur after the firm discharges DS. Therefore, the number of shirkers in the current period affects the risk of random layoffs in the next period. A

1) In this paper, 'shikers' refers only to those workers who shirk in a certain period. It does not mean a type of workers who always shirks. Infinite horizon monitoring models with a discrete effort level like Shapiro and Stiglitz(1984) simply assume that a worker who shirks now will also shirk in the future.

2) this paper can be extended by releasing(A2). Since discharging workers entails turnover costs, the firm may not discharge all of detected shirks to save the costs. Those who are interested in this issue may want to read the extension section in chapter III of my Ph. D thesis.

worker behaves strategically because the other workers' decision of whether to shirk or not affects his layoff rate and thus his life-time utility level. This paper attempts to combine a monitoring scheme with strategic behavior among agents.

The strategic behavior of workers introduces disincentive effect of an increasing wage profile. Efficiency wage models including Lazear(1981), Lazear & Moore(1984) and Yellen(1984) argue that an increasing wage profile strengthens work incentives because a high wage in the next period is a cost of shirking. This paper, however, will show that the increasing wage profile may weaken work incentive.

Second, a distinction can be made between the income of randomly laid-off workers and that of DS. This is possible by introducing disqualification provision of DS for unemployment insurance benefit (UIB). This new element of the model has an important implication for the role of UIB on work incentives. Shapiro and Stiglitz(1984) argues that a worker is more likely to shirk if there is an UI system because UIB decreases the penalty associated with a dismissal. However, this paper will show that Shapiro and Stiglitz's result is reversed when fired shirkers are disqualifed for UIB.

The idea that a discharged shirker should be worse off than a worker who happens to draw an unemployment lottery appeals to our sense of equity. It is also consistent with U. S. law. According to Haber & Murray(1964):

"At least six classes of disqualifying actions are common to the state UI acts in the U. S. These provide for denial of benefits in cases of… discharge for misconduct connected with the work[3]…"

Due to the ambiguity of the word 'misconduct', a legal judgement must be made to determine whether or not a shirker should be disqualified for UIB. According to a Wisconsin Supreme Court decision, a shirker is disqualified for UIB if the shirking behavior is deemed an intentional decision.[4] Since a worker in this paper solves a maximization problem to decide whether or not to shirk, the shirking behavior is obvi-

3) The other cases are: leaving without good cause, refusal of suitable work, participation in labor disputes, the receipt of disqualifying income, and making fraudulent claims.

4) Haber & Murray(1966) p. 297 quote from 237 Wis. 249, 269 N.W. 636, 640(1941): "The application of the term 'misconduct' … is limited to conduct evincing such willful or wanton disregard of an employer's interest as is found in deliberate violations or disregard of standards of behavio which the empoler has the right to expect of his employee, …"

ously an intentional decision, and therefore, a shirker should be disqualified.

The content of this paper is as follows: Section 2 surveys related literature, and shows how they are different from this paper. Section 3 presents a basic model with random layoffs. The behavior of a worker and the firm under a strategic setting will be examined. Section 4 suggests new perspectives on the traditional efficiency wage theory based on the model described in Section 3. Finally, section 5 draws conclusions.

II. Literature Survey

Monitoring worker's effort is a discipline device in this paper, but it is imperfect. This imperfection can be modeled in two different ways as noted by Putterman & Skillman(1988).

The first way is to assume that increased monitoring intensity affects the worker's effort choice by altering the distribution of the noise factor in monitoring. This specification of monitoring technology is called 'monitoring as a noisy signal of effort', and adopted by Bulow & Summers(1986) and Esfahani & Salehi-Isfahani(1989) in explaining the dual labor market.

In this monitoring technology, it is possible that the firm can erroneously accuse assiduous workers of shirking or erroneously keep shirkers on the payroll. Therefore, whether or not the firm has the burden of proof in dismissing workers is very important. Staten & Umbeck(1982) empirically show that stronger burden of proof on the part of the government decreases the work effort of air traffic controllers. Levine(1989, 1991) provides good insights for just-cause policy.

This paper follows the second specification of monitoring technology, 'monitoring as probabilistic observation': The firm has no signal of effort if the worker is not observed, but can determine his effort level with perfect accuracy if he is observed.

Calvo & Wellisz(1978), Shapiro & Stiglitz(1984), Calvo(1985), Strand(1987) and Dickens et. al(1989) apply this type of monitoring to discrete effort decisions. This paper is similar to those models. On the other hand, in Bowles(1985), Sparks(1986) and Nantz & Sparks (1990), the effort level is a continuous variable, and the last two papers introduce a minimum required effort level under which the worker has a positive probability of being detected shirking.

In this probabilistic monitoring technology, if shirkers are not detected, the firm can not distinguish these not-detected shirkers from non-shirkers since the information on worker's effort is asymmetric. These not-detected shirkers and non-shirkers (NDSNS) are treated equally by the firm. Therefore, the firm absorbs the risk of monitoring error, and workers are protected against erroneous dismissal (Nantz & Sparks; 1990, p. 37). However, the moral hazard problem on the part of the firm still remains. In other words, if a diligent worker is dismissed, it is a willful not an erroneous decision by the firm.

The core of this paper is that random layoffs as well as discharging shirking affects work incentives. Some other literature also have noted that a risk of unemployment including layoffs, quits or turnovers can influence the effort decision. However, previous attempts have neglected that layoffs, quits and turnovers are determined after discharging DS.

Shapiro & Stiglitz(1984) briefly argue that high exogenous quit rates decrease work effort. Their paper differs from mine in that quits are solely workers' decision whereas layoffs are the firm's decision. Since the firm determines both layoffs and the firing of shirkers, the joint decision of layoffs and discharges arises in this paper.[5] Levine(1991) distinguishes shirker's and non-shirker's turnover rates, yet he also fails to recognize the fact that non-shirker's turnover rate is affected by the number of shirkers.

Lindbeck and Snower(1988) explain the effects of a change in the turnover rate on work effort, after distinguishing the substitution and income effect.[6] The main differences are: First, there is no monitoring technology in their paper. Second, the turnover rate,

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5) Besides, there is a flaw in their formulation: A montiored shirkers' chance of unempoymont = exogenous quite rate(b) + probability of bening monitored to shirk(q). A question arises regarding the above equation Is b a ratio to the whole employed workers or to NDSNS? If the answer is the latter, the monitored shirker's probability of losing his job should be $q+(1-q)b$ not just $b+q$. If b is the ratio to whole employed workers as it seems in their paper, $b+q$ can be strictiy greater than 1, which contradicts the definition of probability. If they adopted $q+(1-q)b$ as the monitored shirker's probability of losing a job, strategic behavior would have arisen.

6) A fall in the tuenover rate raises the work effort through the substitution effect because a diligent worker is more likely to be rewared. The income effect, however, lowers the work effort bacause smaller risk of losing a job raises the worker's expected income, and enables him to afford shirking.

which is the only risk of unemployment in their paper, is endogenously deterministic whereas laying off NDSNS is state-dependent and therefore probabilistic in my paper.

One of the by-products of the joint consideration of random layoffs and discharges for shirking is the strategic behavior of workers. This requires multi-agent model, and there are abundant game literature.[7)]

All those models, however, take as given the existence of the observable effort-output relationship. Therefore, those multi-agent models were not compatible with monitoring literature. As Miyazaki(1984) notes, monitoring models have used the framework of a principal versus a single agent. This paper, however, attempts to examine the strategic behaviors among workers in a monitoring scheme.

III. A Effort Decision Model with Random Layoffs

A worker lives for three periods; he is young in the first period, becomes old in the second period and retires in the third period. I assume that there is no overlapping generation of workers in the work place: a young worker is born after the old generation retires. A worker is endowed with e units of indivisible labor in each of the first two periods. I assume that all workers are identical in the sense that they have the same skills and utility functions $U(w_j, e) = \sqrt{w_j} - e$, where w_j is the wage in period j and e is the effort level. The utility level of a worker in each period is therefore:

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7) They are classified into one of two categories depending on the compensation rules. One is ordinal evaluation: the highest prize to the worker with the highest output, the second prize to the worker with the second highest output, and so on. Tournament literature including Lazer &Rosen(1981) and Nalebuff&Stiglitz(1983) are in this category. The other is cardinal evaluation: the payoffs are an increasing function of the group production. Holmstrom(1982) shows that noncooperative behavior yields an inefficient outcome if joint output is fully shared among the agents. Miyazaki(1984) also introduces a situation where a firm can only oberve the average effort input each of work group but cannot monitor the individual worker's effort. He then shows that all the other worker's average effort supply in the group has a negative effect on one's own effort level.

$\sqrt{w_j}$ if he is shirking

$\sqrt{w_j}-e$ if he is working hard

0 if he does not work.

This paper depicts the employment relation as a Stackelberg game with interactions between a firm and its workers. Since workers are generally less organized than the firm, the first move is assigned to the firm. After observing the state of the first period, the firm offers young workers w_1, w_2, the first-period employment level(N_1) and retirement grants(R) and state-contingent employment level of the second period [$N_2(x_2)$] under the presumption that workers will optimally react to the offer. As Lindbeck and Snower (1986, p. 235) have pointed out, all the labor market power rests with the firm in the efficiency wage model, and it also holds true in this paper. An equilibrium occurs when actions of all agents are mutually consistent.

In the first two periods, workers have three options: (i) turn down the contract and remain unemployed, (ii) take the contract and shirk. (iii) take the contract and work hard. Therefore, in each period two constraints must be met in order for the worker to work hard. One is the participation constraint; the worker must voluntarily sign the contract. The second constraint requires that the participating worker exert a high level of effort. This is called incentive constraint.

Without any discipline device, the worker would have an incentive to shirk because the compensation does not reflect his effort level. However, if the firm discharges detected shirkers, a worker will exert himself for fear of losing his job in the next period. The probability of being detected shirking is q, and it is assumed to be fixed in this paper.

One problem of this three-period model is that the threat of firing shirkers does not work as a discipline device in the second period because the worker must retire anyway. Therefore, all workers will choose to shirk in the second period. Hiring new young workers in the second period is not possible because I assumed no overlapping generation. The firm's reaction would be then to fire all the workers at the end of the first period and close the firm during the second period. Again, the workers cognizant of the firm's strategy, would shirk in the first period as well because they are certain of losing their jobs in the next period. The whole system breaks down.

As a result, I must consider discipline devices other than the threat of firing that can be applied to the second period. This paper proposes retirement grants. By this scheme, the employed worker will forfeit his retirement grants if he is caught shirking in the second period. Three assumptions are made regarding the retirement grants.

(A3) The retirement grant (R) is an increasing function of w_2, i.e. $R = k\sqrt{w_2}$, where k is assumed fixed and greater than 0.

(A4) Employment in the second period is required as a qualification for the retirement grant. Therefore, the worker who was employed in the first period but unemployed in the second period cannot claim retirement grants. In other words, there is no vesting of pension right.

(A5) The retirement grant is an increasing function of the claimant's tenure with the firm. Therefore, a claimant who is newly hired in the second period receives αR $(0<\alpha<1)$ whereas a claimant who has worked in the same firm since the first period receives R. This paper assumes that α is exogenous and that productivity is not a function of tenure.

An interesting implications for the traditional efficiency wage theory is suggested by (A5). Shapiro & Stiglitz(1984) and Sparks(1986) argue that if the economy is in full employment, everyone will shirk because a fired worker can be re-employed right away.

In this paper, however, some workers may work hard even in a full-employment economy since their retirement grants are a function of their length of employment in a firm to which they claim the retirement grants. This is so because two penalties are imposed on fired shirkers. One is the possibility of not finding a new job. The other is a decrease in one's retirement grant. Full employment eliminates the first penalty, but the second penalty remains.

Because the firm can pay smaller retirement grants to newly hired old workers, the firm has an incentive to replace all the workers in the second period by falsely accusing the innocent workers of shirking. This can be prevented by a reputation effect: If workers know that the firm dismisses all the workers at the end of the first period, they will choose to shirk. Since a firm lives an infinite life, it is not a strong assumption that the reputation effect keeps the firm from moral hazard.

There are three different utility levels in the second period. Since the level of w_1, w_2 are determined in the first period, each level of second-period utilities is known to workers.

The first is U^{2E}, in which case the worker starts the second period being employed. His utility level will depend on whether he shirks or not in the second period.

U^{2E} when shirking in the second period $= U^{2E}\backslash S = \sqrt{w_2} + (1-q)R$

U^{2E} when not shirking in the second period $= U^{2E}\backslash NS = \sqrt{w_2} - e + R$

The incentive constraint in the second period is $U^{2E}\backslash NS \geqslant U^{2E}\backslash S$, which requires $R \geqslant e/q$. If the firm does not satisfy this condition, everyone will shirk and production will be zero in the second period. Therefore, when the firm offers a contract at the beginning of the first period, R should be set high enough to meet the incentive constraint.

Another utility level in the second period is U^{2N}, in which case a worker is randomly laid off at the end of the first period. With probability h, he finds a new job, in which case his utility is $U^{2E'}$. If he does not find a job, he receives UIB(g). Because his retirement grant is only ∂R, $U^{2E'}$ is smaller than U^{2E} by (A5).

$$U^{2N} = (1-h)g + hU^{2E'}$$
$$\text{where } U^{2E'} = \sqrt{w_2} - e + aR$$

The third is U^{2M}, in which case the worker is discharged for shirking at the end of the first period. Unlike the case of U^{2N}, the worker is disqualified for UIB so that he may end up with nothing with probability of $1-h$.

$$U^{2M} = hU^{2E'} + (1-h)0$$

The firm lives an infinite life, and has a production function f with one input, labor. A variable $x_j \in [0, \infty)$ represents the period j price level with c.d.f. F(x). After observing the outcome of x_1, the firm offers a two-period contract that specifies w_1, w_2, N_1, R and state-contingent N_2.

At the end of the second period, all the workers in the firm retire, and the firm again offers a two-period contract to another generation of young workers after observing the outcome of x_3. I assume that workers newly employed in the second period must follow the contract that has been made by the incumbent workers in the first period.

Under the assumption that workers will behave optimally, the firm chooses the optimal level of N_1, w_1 and w_2 by maximizing the following problem after observing x_1.

$$\underset{w_1,\, w_2,\, N_1}{Max}\ \pi = \pi_1 + E\pi_2$$
$$\pi_1 = x_1 f[(1-r^*)N_1] - w_1 N_2 - M(q)$$
$$E\pi_2 = \int_0^{\infty} [x_2 f(N_2) - w_2 N_2 - M(q) - R]\, dF(x_2)$$

$$r^* = optimal\ probability\ of\ shirking = r[w_2, N_1, N_2(x_2)]$$

The following constraints must be met.

(C1) the first-period participation constraint:

$$e \leqslant \sqrt{w_1} + (U^{2E} - U^{2M}) \leftrightarrow \sqrt{w_1} \geqslant e - (1-h)(\sqrt{w_2} - e) - (1 - \alpha h) e/q.$$

Since w_1 has nothing to do with work incentives, the firm tries to minimize w_1. Therefore, (C1) is always binding: $\sqrt{w_1} = e - (1-h)(\sqrt{w_2} - e) - (1 - \alpha h) e/q$.

It is important to note that w_1 is a decreasing function of w_2.

(C2) the first-period incentive constraint:

$$e \leqslant q(U^{2E} - U^{2M}) \leftrightarrow e \leqslant q[(1-h)(\sqrt{w_2} - e) + (1 - \alpha h)R]$$

This constraint states that the worker is worse off by shirking when there is no risk of random layoff. This is very similar to the non-shirking condition derived in Shapiro and Stiglitz(1984, p. 436). If this condition is not met in this paper, the Nash equilibrium is attained at $r = 1$, which means all the workers will shirk in the first-period and the production will be zero.

(C3) the second-period participation constraint:

$$U^{2E} \backslash NS \geqslant 0 \leftrightarrow R \geqslant e$$

This condition is not binding when (C4) holds because q is less than 1.

(C4) the second-period incentive constraint:

$$U^{2E} \backslash NS \geqslant U^{2E} \backslash S \leftrightarrow R \geqslant e/q \leftrightarrow \sqrt{w_2} \geqslant ke/q.$$

The second-period profit after observing x_2 and r is as follows:

If $N_2 \leqslant N_1 - qrN_1$:

$$\underset{N_2}{\text{Max}}\ \pi_2 = x_2 f(N_2) - w_2 N_2 - M(q) - N_2 R$$

If $N_2 \geqslant N_2 - qrN_1$:

$$\underset{N_2}{\text{Max}}\ \pi_2 = x_2 f(N_2) - w_2 N_2 - M(q) - (N_2 - N_1 + qrN_1)\ \alpha R - (N_1 - qrN_1)R$$

where

N_1, N_2 is employment level in period 1, 2

$M(q)$ = monitoring cost

$N_1 - qrN_1$ = the number of NDSNS

$N_2 - (N_1 - qrN_1)$ = the newly hired workers in the second period

FOC:[8]

$$x_2 f'(N_2) = w_2 + R \text{ when } N_2 \leqslant N_1 - qrN_1$$

$$x_2 f'(N_2) = w_2 + R \text{ when } N_2 \geqslant N_1 - qrN_1$$

Since w_2 and R were determined at the beginning of the first period, the outcome of x_2 determines the optimal second-period employment level N_2^*. If $N_2^* \geqslant N_1 - qrN_1$, the firm has to hire more workers, and NDSNS will not be laid off. However, if $N_2^* \leqslant N_1 - qrN_1$, some NDSNS must be laid off to meet N_2^*.

[Definition 1] NDSNS's probability of layoff, $\tilde{n}(x_2)$, is:

$$[N_1 - qrN_1 - N_2^*(x_2)]/(N_1 - qrN_1).$$

Proof: Note that $N_1 - qrN_1$ is the number of NDSNS and that $N_1 - qrN_1 - N_2^*$ is the number of NDSNS who have to be laid off to meet the N_2^*. Lemma 1 holds by the definition of $\tilde{n}(x_2)$.

[Definition 2] Let $x_2^* \in X$ be the upper bound of x_2 s.t. $N_2(x_2) \leqslant N_1 - qrN_1$. In other words, in the state worse than x_2^*, NDSNS will face the risk of layoff in the second period. Then:

$$N_2(x_2^*) = N_1 - qrN_1.$$

The c.d.f. $F(x_2^*)$ is the probability that NDSNS face a positive probability of layoffs, in other words, $F(x_2^*)$ is the probability that $\tilde{n}(x_2)$ is positive. Once x_1, w_2 and N_1 are known a worker can calculate $F(x_2^*)$. When x_2 is better than x_2^* with a probability $1-F(x_2^*)$, there is no risk of random layoff for NDSNS, and a shirker will get U^{2E} if he is not detected and U^{2M} if detected.

If x_2 is worse than x_2^* with a probability $F(x_2^*)$, random layoffs sre expected to be

8) The FOCs show that there may exist two optimal N_2 when the state is good. However, as long as the firm has a consistent rule to choose between the two equilibria, the qualitative results in this paper are not affected. I assume that the firm always chooses the higher level of N_2. This assumption guarantees a nice continuity around $N_2^* = N_1$.

necessary to meet the smaller employment level. Therefore, NDSNS are also subject to unemployment with a chance of $\tilde{n}(x_2)$ for each random variable x_2. The probability $\tilde{n}(x_2)$ is affected by the percentage of works who shirk in the first period because the the firm dismisses the detected shirkers first before randomy laying off NDSNS to meet N_2^*. This brings about strategic effort decisions among works.

This model is a game of binary choices with externalities as discussed in Shelling(1791). Let the function V( ) be the life-time utility of a worker. The function V( ) depends on whether or not he shirkers in the first period: it is V^S if he shirks, and is V^{NS} if he does not shirk.

The worker will use pure straegy if either $V^{NS}(r=0) \geqslant V^S(r=0)$ or $V^{NS}(r=1) \leqslant V^S(r=1)$ is ture. In such cases, everyone works hard($r^*=0$) or everyone shirks($r^*=1$) at equilibrium. Since r^* does not continuously react to wage or UIB in the case of pure strategy, this paper concentrates on the interior solutions by the following assumption.

[A 6] The equlibrium r is assumed to be interior: $0 < r^* < 1$.

(i) The condition $r^* < 1$ is satisfied by [C2], the first period incentive constraint.

(ii) The condition $r^* < 0$ is met by the following.

$$V^S(r=0) > V^{NS}(r=0) \leftrightarrow e > q[(U^{2E}-U^{2M}) - En(U^{2E}-U^{2N})]$$

$$En = \int_0^{x_2^*} \frac{N_1 - N_2(x_2)}{N_1} dF(x_2) \ \ where\ x_2^*\ satisfies\ N_2(x_2^*) = N_1$$

Unlike the case where NDSNS are fre from the risk of layoff, not all workers may work hard in this case. Instead, they use mixed strategy; they will shirk with probability r and work hard with probability 1-r. Therefore, rN_1 is the number of shirking workers in first period. I assume that rN_1 is not affected by one's effort decision. This is sustained by a large number of workers and thier Nash perception.

This paper is seeking stable Nash equilbria. Strategy set of a worker i is $e_i = \{0, e\}$ for $i \in [0, N_1]$. The normal from of this game is:

$$\begin{aligned} V_i(e_i, r) &= V^S(r)\ if\ e_i = 0 \\ &= V^{NS}(r)\ if\ e_i = e \end{aligned}$$

$$where\ r = \frac{1}{N_1} \int_0^{N_1} \frac{e_i}{e}\, di$$

$$V^{NS}(r) = \sqrt{w_1} - e + [1 - F(x_2^*)]U^{2E} + \int_0^{x_2^*(r)} \{[1 - \tilde{n}(x_2)]U^{2E} + \tilde{n}(x_2)U^{2N}\}\, dF(x_2)$$

$$= \sqrt{w_1} - e + U^{2E} - (U^{2E} - U^{2N})E\tilde{n}$$

$$V^{NS}(r) = \sqrt{w_1} + [1 - F(x_2^*)][(1-q)U^{2E} + qU^{2M}] +$$

$$\int_0^{x_2^*(r)} \{(1-q)[(1-\tilde{n}(x_2))U^{2E} + \tilde{n}(x_2)U^{2N})] + qU^{2M}\}dF(x_2)$$

$$= \sqrt{w_1} + (1-q)U^{2E} + qU^{2M} - (1-q)(U^{2E} - U^{2N})E\tilde{n}$$

$$where\ E\tilde{n}[r,\ x_2^*(r)] = \int_0^{x_2^*(r)} \tilde{n}(x_2)dF(x_2)$$

The Nash equilibrium r* is attained where shirking and non-shirking provide the same lifetime utility level, that is, $V^S(r^*) = V^{NS}(r^*)$

$$V^S(r) = V^{NS}(r) \leftrightarrow e = q[(U^{2E} - U^{2M}) - E\tilde{n}(U^{2E} - U^{2N})]$$

$$\leftrightarrow E\tilde{n} = \frac{U^{2E} - U^{2M} - e/q}{U^{2E} - U^{2N}} \equiv Z(\ )$$

$$Let\ E\tilde{n} - Z(X) \equiv \Phi(\ ),\ At\ equilibrium,\ \Phi(\ ) = 0$$

It is very troblesome to derive an explicit form of r* because we need to know the exact functional forms of both $N_2(x_2)$ and $F(x_2)$. However, the following lemma is enough to derive the results of this paper.

[Lemma 1] The following (i) and (ii) prove that NDSNS's expected layoff rate $E\tilde{n}[r, x_2^*(r)]$ decreases as more workers shirk in the first period.

(i) NDSNS are less likely to face a positive risk of random layoffs as r increases.

(ii) When NDSNS face a positive risk of random layoffs, the probability of layoffs decreases as r increases.

Proof(i): As more workers choose to shirk, more workers will be discharged, and the remaining workers are less likely to outnumber the optimal second period employment level. This is proved by $\partial F[x_2^*(r)]/\partial r < 0$. Since $F'(x_2) > 0$, it is sufficient to show that x_2^* is a decreasing function of r. This is evident from $N_2(x_2^*) = N_1 - qrN_1$.

Proof(ii): This is proved by showing that $\tilde{n}(x_2)$ is a decreasing function of r. Check $\partial\tilde{n}(x_2)/\partial r < 0$ from the definition 1.

From (i) and (ii), the Lemma is proved.

IV. New Perspectives on Efficiency Wage Theory

From the implicit function $\Phi(\ )=0$, this paper derives a couple results different from what the traditional effency wage theory suggests. Of course, all the necessary conditions for implicit function theorem are assumed satisfied.

[Proposition 1] A higer UIB decrease shirking.

Proof: From $\Phi(\ )$ and Lemma 1, the following holds:

$$\frac{dr}{dg} = -\frac{\partial\Phi/\partial g}{\partial\Phi/\partial r} = \frac{\partial Z/\partial g}{\partial E\tilde{n}/\partial r} < 0$$

$$\because\ \frac{\partial E\tilde{n}}{\partial g}=0,\ \frac{\partial Z}{\partial g}>0,\ \frac{\partial E\tilde{n}}{\partial r} < 0$$

UIB makes a difference in the utility level between fired shirkers and randomly laid-off workers. If the unemployed worker could not get a new job immediately, he will get either UIB or nothing depending on why he was unemployed. If the unemployed worker was working hard but unlucky to draw a layoff lot, he gets UIB. If he was shirking, he receives nothing. Therefore, UIB is a cost of shirking.

When UIB increases, the life-time utility of both a shirker and a non-shirker increases as well. Because a shirker's utility is a affected by UIB only if he is not detected with a probability of 1-q, the life-time utility of a non-shirker increases more than that of a shirker. Therefore, higer UIB increases the benefit of non-shirking.

The presence of insurance is believed to raise a problem of moral hazard. However, this proposition argues that the insurance system can strength the work incentive if the insurer can monitor the moral hazard of the insured and disqualifies the detected from the insurance benefit, the insured execise more care. The next problem is whether monitoring is possible. Since the moral hazard caused by UI occurs in a limited area like a work place, it is more easily detected than the moral hazard induced by health or life insurance.

This paper assume that experience rating is zero. However, under the present experience rating which is generally less than 1, the firm can save UI tax by falsely accusing randomly laid-off workers of shirking. However, this moral hazard problem of the firm will be mitigated by the reputation effect of the firm. If workers learn that the firm will falsely accuse innocent workers of shirking, they think that the benefit of working hard, which is UIB, will be dampened by the moral hazard of the firm.[9] This paper assumes that the reputation effect keeps the firm from moral hazard.

In the following, the effect of increasing wage profile on work incentives will be examined.

[Lemma 2] If a higher w_2 is offered with a lower w_1 satisfying(C1) with eqality, NDSNS's expeted layoff rate increase.

$\leftrightarrow \partial E\tilde{n}[r, x_2^*(r)]/\partial w_2 > 0.$

Proof: From $x_2 f'(N_2) = w_2 + R = (1+k)w_2$ a higer w_2 with a lower w_1 decreases the optimal N_2 for each x_2, and increases N_1. As a result, random layoffs are more likely to occur, which leads to a higher x_2^* since x_2^* is the highest x_2 in which random layoffs can take place. This affects $E\tilde{n}$ in two ways:

(i) The situation where there is a risk of layoffs for NDSNS is more likely to happen. x_2^* goes up as w_2 increases.

(ii) The layoff probability of NDSNS decreases. $\leftrightarrow \partial\tilde{n}(\ )/\partial w_2 < 0$

[Proposition 2] If the firm offers a higher w_2 with lower w_1, the work's effort level may decrease.

Proof: From equation $\Phi(\ )$ and Lemma 2:

$$\frac{\partial r}{\partial w_2} = -\left[\frac{\partial E\tilde{n}}{\partial w_2} - \frac{\partial Z}{\partial w_2}\right] / \frac{\partial E\tilde{n}}{\partial r}$$

$$sign\left(\frac{\partial Z}{\partial w_2}\right) = sign\left[\frac{e}{q} - g(1-h)\right] > 0.$$

The second period wage has two effects in this model. First, it determines the employ-

9) This is shown in the following: If we let $\beta \in [0, 1]$ be the degree of moral hazard, β = (the # of randomly laid-off workers who get no UIB)/(the # of NDSNS who are randomly laid off. The equation for the optimal r is:

$$\leftrightarrow E\tilde{n} = \frac{U^{2E} - U^{2M} - e/q}{U^{2E} - U^{2N} + \beta(U^{2N} - \tilde{U}^{2M})}$$

It can easily be shown that a higer β induces more shirking.

ment level and retirement grants. Second, it is a penalty for fired shirkers unless they can get another job. Efficiency wage models have argued that a higher wage in the future periods increases the net cost of shirking, thus strengthening work incentive. This unequivocal result is possible because they have neglected the first role of the wage($\partial E\tilde{n}(\ )/\partial w_2 > 0$) and only emphasized the second role of the wage ($\partial Z(\ )/\partial w_2 > 0$).

However, when the worker behaves strategically based on his expectation of the future employment level, the first role of the wage should be considered, and the total effect of the future wage on the current work incentives are uncertain.

Intuitively, this can be explained as follows: There are two effects of higher w_2. First. since future wages work as a penalty for monitored shirkers, a rise in wages increases the cost of shirking. On the other hand, a higher future wage is more likely to produce layoffs in the second period, in which case, diligent workers are more likely to be laid off. This expectation decreases a benefit of working hard, therefore increases shirking. The total effect of higher wages depends on the relative magnitude of the first and the second effect.

For the same reason, higher retirement grants (higher k) may increase shirking. A high retirement grant will increase the penalty for shirking. However, since it will decrease N_2 without changing N1, workers are more likely to be laid off. Therefore, the benefit of non-shirking decreases, and it weakens work incentives. The total effect is again indeterminate.

Another interesting result of this paper is that work discipline is weaker when the future state is expected worse than now. It is so because the probability of layoffs increases and many hard working people will be laid off anyway.

Traditional efficiency wage theory including Yellen (1984) and Sparks (1986) argues that a state of the economy does not influence the wage level and work effort because wages are determined by incentive considerations that are independent of states. In this paper, however, the outcome of the state affects N_1 and N_2, which in turn affect work incentives.[10)]

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10) A similar result is also proved by Nantz and Sparks(1990). Using a model of a labor managed firm where net income per worker is xf( )/N, they show that higer output price decreases work effort because the income effect(a worker can attain higer net income with low effort) dominates the substitution effect(a worker's return per unit of effort increases). However, I arrive at a similar result based on the incentive effects of employment level whereas in Nantz and Sparks, work effort is unresponsive to changes in the employment level but is dependent on the incentive effect of profit sharing.

V. Conclusion

The main contribution of this paper is to point out that random layoffs and discharges for shirking are jointly determined. This idea adds a couple of new elements into the traditional monitoring literature: strategic effort decision and UIB disqualification provision. Interesting results on worker's discipline in contrast to the basic argument of efficiency wage models, are obtained. First, more UIB strengthens work incentives if detected shirkers are disqualified for UIB. Second, an increasing wage profile may decrease work effort. This paper suggests that in light of the incentive effect of an employment level, the application of the efficiency wage theory should be carefully done.

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