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Employment Protection Legislation and Cooperation under Relational Contracts

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Employment protection legislation and cooperation under relational contracts*

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Abstract

In this paper, I argue how employment protection legislation (EPL) influences relational employment contracts. Firing costs caused by EPL are categorized into two kinds: procedural inconveniences (negotiation costs) and severance pay. I focus on the minimum value of the discount factor that sustains mutual cooperation under trigger strategies, and show that a hike in firing costs first enhances and then dampens cooperation. Additionally, a hike in severance pay leads to moral hazard for workers. EPL processes, especially procedural inconveniences such as negotiations with unions, can enhance cooperative employment relationships as long as they are not large. Moderate, not overly strict, EPL is supportive of cooperative employment relationships.

JEL Classification Numbers: J41, J53.
Key Words: Relational contract, Incentives, Cooperation, and Minimum discount factor

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1. Introduction

Numerous studies have focused on the effects of employment protection legislation (EPL) on the economy, especially from macroeconomic perspectives. However, they have provided ambiguous results. Bertola, Boeri, and Cazes (2000) cite the complexity of social institutions as the main reason for the ambiguity. Difficulties posed by social institutions include industrial relationships with central or local wage bargaining, safety nets such as unemployment insurance, the structure of internal and external labor markets, and so on. These factors differ from country to country and are influenced by different historical and regional backgrounds. Further supporting this view, recent studies by Aghion, Algan, Cahuc, and Shleifer (2010), Aghion, Algan, and Cahuc (2011), and Blanchard and Philippon (2006) point out that state regulation of labor markets is negatively correlated with the quality of industrial relationships. In countries with strict labor regulations such as France and the southern European countries, the quality of industrial relationships is poor. In contrast, in the Nordic countries where moderate regulations exist, cooperative and trusting industrial relationships have been established. These studies imply that microeconomic perspectives on industrial relationships are crucial to evaluate the effects of EPL.

Since conflictual employment relationships are likely to lead to poor performance, it is vital to identify how good employment relationships are associated with strict and moderate EPL. Strict EPL seems to be unnecessary if good relationships have been established; labor market regulations can be substituted for trusting relationships. However, this does not mean that EPL is not needed at all. EPL may support good and trusting relationships. This study aims to consider how EPL influences a cooperative employment relationship.

A good relationship makes it possible to enhance cooperation between a firm and a worker through an implicit relational contract mechanism. A relational contract mechanism is especially crucial when behaviors of firms and workers are not verifiable. When verifiable observations are less accurate at measuring contributions of workers, as Baker (1992) (2002) reveals, it is not beneficial to evaluate workers' contributions with them. As the well-known multitask principal-agent model of Holmstrom and Milgrom (1991) shows, if firms are tempted to base the remuneration of workers on verifiable but inappropriate observations, it does not necessarily bring firms the most benefits. Given the reality of multitasking, as Brown (1990) points out, firms are likely to adopt implicit relational contract mechanisms rather than high-powered incentive schemes based only on verifiable observations. The appropriate motivation of workers can be developed with a relational contract mechanism.

Long-term employment relationships that are formed through a relational contract can induce workers to pay more attention to unverifiable but essential work. EPL can help to support long-term employment relationships; thus, it may enhance good employment relationships. In contrast, the efficiency wage model of Shapiro and Stiglitz (1984), a leading theory, holds that the threat of dismissal is a driving force in worker incentives. EPL may provide a negative impact because shirking workers are not likely to be fired or punished. Therefore, it is important to analyze both the positive and negative effects within the relational contract framework.

In this paper, I consider an employment relationship with a firm and a worker. A firm offers a remuneration package consisting of an explicit-contract basic wage and an implicit-contract bonus. Since the worker's performance is not observed by a third party, the firm cannot make an explicit-contract wage conditional on the worker's performance. The basic wage must be paid regardless of the worker's performance; thus, the firm does not offer incentives to the worker. An implicit-contract bonus can be a driving force to encourage the worker. However, the implicit bonus payment is under the control of the firm, and thus the firm may not pay the bonus even if the worker has shown good performance. This is a typical hold-up problem whereby the firm does not pay any positive bonus and therefore the worker makes no effort if they play the one-shot game.

To enforce the implicit bonus and encourage the worker to show good performance, a repeated employment relationship must be formed. It is well established through the folk theorem that the firm and the worker will engage in cooperative behaviors when they emphasize more on mutual future benefits; that is, their discount factors are sufficiently high.[1] In this paper, to examine how EPL enhances cooperation, I analyze the effect of EPL on the minimum value of discount factors that sustain mutual cooperation under trigger strategies. Although trigger strategies are restrictive, they make it possible to derive the minimum value of discount factors for mutual cooperation. The approach is similar to Baker, Gibbons, and Murphy (1994), who consider the relationship between subjective but correct performance measures and

[1] Bull (1987) and Macleod and Malcomson (1989), seminal studies on the relational contract theory, analyzed what type of contracts can implement cooperation continuously. Levin (2003) considered an optimal relational contract in the constrained situation in which players confront asymmetric and unverifiable information.

objective but distortionary ones under trigger strategies. They show a complementary relationship between subjective and objective performance measures to implement cooperative behaviors.

Firing costs that firms bear are categorized into two kinds: one is a monetary transfer such as severance pay and the other is a procedural inconvenience such as providing advance notices or negotiations with unions. Although both increase the firing cost for firms, monetary transfer is limited to earnings for workers, but procedural inconvenience results in wasteful loss. Monetary transfer seems to be better, but it also benefits shirking workers and may dampen worker incentives. This difference is crucial in the analysis of the effects of EFL.

The main conclusion of this study is that as the firing cost increases, the minimum discount factor that sustains mutual cooperation first decreases, and then increases. In other words, initially EPL enhances industrial relationships and supports cooperative employment relationships, but as it is strict, it eventually dampens relationships. EPL plays a positive role in deterring the firm from exploiting output without paying a bonus. However, EPL can also have a negative effect on worker incentive. When EPL is moderately strict, the former positive effect on industrial relationships overrides the latter negative one. In contrast, in the case of strict EPL, the positive effect is dominated by the negative one. Moreover, it will be shown that, as the fraction of monetary transfer in the firing cost increases, a cooperative employment relationship is unlikely to be sustained. Therefore, we conclude that moderate EPL enhances mutual cooperation, and negotiation with unions is more crucial than severance pay.

This paper contributes to the literature on the effect of EPL on incentives. As the efficiency wage model suggests, EPL seems to have a disincentive effect. However, it has also been shown that EPL can provide a positive effect on incentives by several studies such as Fella (2000), Galdon-Sanchez and Guell (2003), Suedekum and Ruehmann (2003), Belot, Boone, and van Ours (2007), and Demougin and Helm (2011). Although the theoretical frameworks of these studies differ, they are limited to one-shot relationships in which EPL plays a significant role as a kind of commitment device. In contrast, I focus on the effects of EPL on the sustainability of cooperative employment relationships through a relational contract, and show that cooperative relationships can be built with appropriate EPL.

This paper is organized as follows. Section 2 presents the structure of an infinitely repeated game model in which a firm and a worker play trigger strategies.

There are two phases: cooperative and punishment. First, I consider the punishment phase in section 3. Next, in sections 4 and 5, I show equilibrium remuneration and the effects of EPL on cooperation *after* and *before* establishing a relationship, respectively. Finally, section 6 presents the conclusions.

2. Model

1. Model

I consider an employment relationship between a firm and a worker. A firm requires a worker to make an effort to produce a high output. If a worker bears the effort cost of μ, he produces the output of $y = 1$ over the effort cost μ. If he shirks his work, he produces nothing, $y = 0$. I assume that the worker's contribution is observable to the firm, but is too complex and subtle to be verified by a third party, and so cannot be the basis of an enforceable contract. The output is subjectively assessed inside the employment relationship.

Remuneration consists of a basic wage w and an implicit-contract bonus b. A firm offers a worker a remuneration package, $p \equiv (w, b)$. The firm can decide on a basic wage and a bonus freely as long as it is non-negative. The firm must pay the basic wage w regardless of the worker's performance whenever he is employed. The basic wage is always enforced by a third party, such as a court. On the other hand, the third party cannot require that any implicit-contract bonus be fulfilled. The bonus can be paid after the worker's performance is revealed. Profit of the firm in a period is given by $\pi = y - w - b$ if the firm pays the bonus.

The employment relationship can be infinitely repeated, and a worker and a firm play trigger strategies. Therefore, the worker and the firm begin to cooperate and then continue cooperating unless either of them defects. If either of them deviates from cooperation, they refuse to cooperate forever after.[2]

2. Timing of behaviors

Here, the timing of events within each period is considered. Formally, each period t is divided into four subperiods; t^0 in which the firm offers a remuneration

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[2] The trigger strategies have the virtue of being simple to analyze. As a result, I do not consider an optimal punishment scheme and renegotiation, which are beyond my focus in this paper.

package $p_t = (w_t, b_t)$ to the worker; t^1 in which the worker decides on quitting ($q_t = 0$) or not ($q_t = 1$); t^2 in which the worker makes a decision on his output, $y_t = 0$ or 1, if he remains in the firm; and t^3 in which the firm pays the basic wage and gives, or does not give, the bonus. Then, the next period comes, and the same behaviors are repeated if the employment relationship continues. The timing of the behaviors is summarized in figure 1.

The firm makes a decision on a bonus payment after observing the worker's behavior. The employment relationship can be dissolved in subperiod t^1 of a period t; a worker can quit after observing a remuneration package $p_t = (w_t, b_t)$ and before generating output in the period. The firm commits a basic wage in subperiod t^0, then pays it in subperiod t^3. This indicates that the firm has to pay the basic wage after the production process has been completed in subperiod t^2, but does not have to pay before it has been completed. In other words, if the worker quits the firm in subperiod t^1, the worker cannot get the basic wage w_t but the gets outside wage $\overline{w}$.

3. Firing cost

The firm bears firing cost f caused by EPL when an employment relationship is broken off. The firing cost consists of an administrative cost, which is a socially wasteful transaction cost such as procedural inconveniences, and a monetary transfer such as severance pay. On the discussion of EPL, it seems to be natural that firms bear a firing cost whenever they fire workers, but firms do not bear this cost when workers leave their jobs voluntarily. However, we must realize that firms are willing to pretend not to fire workers and avoid a firing cost if workers quit voluntarily. In fact, firms can induce workers to leave by lowering their remuneration. This seems to be the voluntary turnover of workers, but in essence they are fired. If this was not accepted as firing but instead as voluntary turnover, EPL would not function. It would just be a veil. In this paper, to consider the effect of EPL, it is assumed that a firm has to bear the firing cost regardless of the reasons of why a worker quits his firm, involuntarily or voluntarily. The firm must incur the firing cost whenever the employment relationship is dissolved.

Once an employment relationship has been established, the firm has to bear the firing cost upon dissolving the employment relationship. In contrast, in the beginning of period 1, the employment relationship has not been established yet; thus, the firm does not incur the firing cost when the worker rejects the firm's offer. As I show later, this difference is crucial.

When the employment relationship is broken off, the firm bears firing cost f, which consists of a monetary transfer kf and administrative cost $(1-k)f$, where k ($0 \le k \le 1$) is a parameter representing the fraction of the monetary transfer in the firing cost. The firing cost and the fraction of the monetary transfer are exogenously given as a social rule in the economy.[3]

In the incumbent period in which the employment relationship is broken off, payoffs of the firm and the worker are $-f$ and $kf + \overline{w}$, respectively.[4] Since the worker rejects the offer before producing output, the worker works outside the firm and gets the outside wage $\overline{w}$ in addition to the severance pay kf. Then, in the next period or later, payoffs of the firm and the worker are 0 and $\overline{w}$, respectively.

4. Trigger strategies

Let a_t denote an outcome of these decisions in period t: $a_t = \{p_t, q_t, y_t, b_t\}$. The histories that are common knowledge to the firm and the worker are given by,

$$h(t^0) = (a_1, a_2, \ldots, a_{t-1}), \text{ where } h(1^0) = \phi,$$
$$h(t^1) = h(t^0) \cup \{p_t\},$$
$$h(t^2) = h(t^1) \cup \{q_t\},$$
$$h(t^3) = h(t^2) \cup \{y_t\}.$$

The firm and the worker can observe all of their behaviors; they do not face any problems caused by asymmetric information. I focus on the subgame perfect Nash equilibrium of this model. In the repeated game with perfect information, there are two phases under trigger strategies: cooperative and punishment. In the cooperative phase, the worker produces high output and the firm pays the bonus. I denote the outcome of a period t that belongs to the cooperative phase as,

3 In the real world, the fraction of the monetary transfer and administrative cost in the firing cost tend to be dependent on the history and quality of employment relationships. Fired workers may receive generous severance pay at a low administrative cost under good employment relationships. In contrast, it may take a long time to reach an agreement between firms and fired workers under poor relationships. In this case, the administrative cost is likely to be large. Thus, this model can be applied to various situations by appropriate adjustment of the parameters.

4 In period 1, the current payoffs of the firm and the worker are 0 and $\overline{w}$, respectively, when the worker rejects the firm's offer because the employment relationship has not been established.

$$a_t = \begin{cases} a_1^* \equiv \{(w_1^*, b_1^*), 1, 1, b_1^*\} & if \;\; t = 1, \\ a^* \equiv \{(w^*, b^*), 1, 1, b^*\} & if \;\; t = 2, 3, ... \end{cases}$$

Formally, the trigger strategy of the firm is as follows:

$$p_t(h(t^0)) = \begin{cases} (w_1^*, b_1^*), & if \;\; t = 1, \\ (w^*, b^*), & if \;\; t \geq 2 \;\; and \;\; h(t^0) = (a_1^*, a^*, ..., a^*), \\ (w_d, 0), & otherwise; \end{cases}$$

$$b_t(h(t^3)) = \begin{cases} b_1^*, \;\; if \;\; h(1^3) = \{(w_1^*, b_1^*), 1, 1\}, \\ b^*, \;\; if \;\; t \geq 2 \;\; and \;\; h(t^3) = (a_1^*, a^*, ..., a^*, \{(w^*, b^*), 1, 1\}), \\ 0, \;\; otherwise. \end{cases}$$

The trigger strategy of the firm indicates that in period 1, the firm offers the remuneration package (w_1^*, b_1^*). Then, if the worker accepts the firm's offer and the output of the worker is $y = 1$, the firm pays the bonus b_1^*. Otherwise, the firm does not. In period t (= 2, 3,…), if the outcome of all $t - 1$ preceding periods has been in the cooperative phase, the firm offers the remuneration package (w^*, b^*) and pays the bonus. Otherwise, the firm offers a different remuneration package $p_t = (w_d, 0)$.

Similarly, the trigger strategy of the worker is defined as follows:

$$q_t(h(t^1)) = \begin{cases} 1, \;\; if \;\; h(1^1) = \{(w_1^*, b_1^*)\} \;\; or \;\; w_1 \geq \overline{w}, \\ 1, \;\; if \; t \geq 2, \; and \\ \quad [1] \; h(t^1) = (a_1^*, a^*, ..., a^*, \{(w^*, b^*)\}) \;\; or \;\; [2] \;\; w_t \geq (1-\delta)kf + \overline{w}, \\ 0, \;\; otherwise; \end{cases}$$

$$y_t(h(t^2)) = \begin{cases} 1, \;\; if \;\; h(1^2) = \{(w_1^*, b_1^*), 1\}, \\ 1, \;\; if \; t \geq 2 \;\; and \;\; h(t^2) = (a_1^*, a^*, ..., a^*, \{(w^*, b^*), 1\}), \\ 0, \;\; otherwise. \end{cases}$$

The trigger strategy of the worker indicates that in period 1, the worker accepts the firm's offer and generates high output if the remuneration package (w_1^*, b_1^*) is offered. In period t (= 2, 3,…), if the outcome of all $t-1$ preceding periods has been in the cooperative phase, the worker remains in the firm and makes an effort to generate output. Otherwise, the worker will shirk his work duties or quit the firm.

Note that in the punishment phase the worker is willing to remain in the firm when the basic wage offered is equivalent to or more than his alternative payoff. The alternative payoff depends on whether the employment relationship has been established. Once the relationship has been established, the worker is willing to remain in the firm in the punishment phase if the basic wage offer is equivalent to or more than $\overline{w}+(1-\delta)kf$, which is the average payoff per period that the worker receives by quitting. When the relationship has not been established in period 1, the worker will accept the firm's offer if a basic wage offer is equivalent to or more than the outside wage $\overline{w}$. As I show in the next section, when the firing cost is huge, the firm is willing to maintain the employment relationship even if the worker will not produce anything.

3. Punishment phase

The behaviors of the firm and the worker in period 1 depend largely on their expected future behaviors; thus, I proceed to consider period 2 or later. First, I have to deliberate the punishment phase, where the worker does not produce anything and the firm does not pay any bonus.

The punishment phase will continue forever once either the firm or the worker deviates from the cooperative phase.[5] In the punishment phase, the firm can choose two states, "firing" and "dead wood," through the basic wage offer. "Firing" means dissolving the employment relationship by offering a basic wage lower than the worker's alternative payoff. In contrast, "dead wood" indicates continuing the relationship by offering a basic wage sufficient enough to maintain the relationship. The firm realizes that the worker generates no output; he is nothing but "dead wood." However, the firm will maintain the employment relationship in the punishment phase when the firing cost f is very large. To make the worker remain in the firm, a basic wage plays a significant role. It can deter the worker from quitting the firm, but a bonus offer

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5 Under the trigger strategies, players never return to the cooperative phase. In section 6, I mention a case in which they can return to the cooperative phase.

cannot because it is not credible for the worker in the punishment phase.

The firm is willing to continue employing the worker as dead wood in the punishment phase when it holds that $f \geq \sum_{i=0}^{\infty} \delta^i w_d$, where the discount factor denoted as $\delta(\leq 1)$ is common for the worker and the firm. On the other hand, the worker will remain in the firm when it holds that $kf + \sum_{i=0}^{\infty} \delta^i \overline{w} \leq \sum_{i=0}^{\infty} \delta^i w_d$. If the two inequalities hold simultaneously,

$$\delta < \delta_1(k, f) \equiv 1 - \frac{\overline{w}}{(1-k)f}, \qquad \ldots(1)$$

the employment relationship continues even in the punishment phase. The firm will offer the minimum value of the basic wage if it is willing to maintain the employment relationship: $w_d = \overline{w} + (1-\delta)kf$. Otherwise, the firm will offer a basic wage strictly less than $\overline{w} + (1-\delta)kf$, for example, $w_d = 0$; thus, the worker quits and the employment relationship is broken off. The behaviors in the punishment phase, therefore, depend on the strictness of EPL.

Lemma 1

The trigger strategies of the firm and the worker are the best responses to their partners' strategies toward each other in the punishment phase. The outcome of a period t in the punishment phase is [1] in the case of $\delta \geq \delta_1(k, f)$, $a_t = \{p_t, q_t, y_t, b_t\} = \{(0, 0), 0, 0, 0\}$ and [2] in the case of $\delta < \delta_1(k, f)$, $a_t = \{(\overline{w} + (1-\delta)kf, 0), 1, 0, 0\}$.

The proof is given in the Appendix. Condition (1) shows that, as the firing cost increases, the employment relationship is likely to continue in the punishment phase. Moreover, as the fraction of the monetary transfer in the firing cost increases, firing tends to be conducted. When the fraction of the monetary transfer is high, the firm has to pay a high basic wage to maintain the relationship. Thus, the firm is likely to induce the worker to quit.

4. After establishing a relationship

1. Incentive conditions of a worker

Next, I consider incentive compatibilities of a firm and a worker to keep the cooperative phase in period 2 or later. Then, we will return to period 1.

First, I analyze the incentive compatibilities of a worker in the cooperative phase. A firm has to offer an equilibrium remuneration package (*w**, *b**) that satisfies the incentive compatibilities of a worker to maintain the cooperative phase. The incentive compatibilities of a worker in subperiod t^1 and t^2 are given by

$$\text{WIC-}q\text{:} \quad \sum_{i=0}^{+\infty} \delta^i (w^* + b^* - \mu) \geq kf + \sum_{i=0}^{+\infty} \delta^i \overline{w}, \qquad \cdots(2)$$

$$\text{WIC-}y\text{:} \quad \sum_{i=0}^{+\infty} \delta^i (w^* + b^* - \mu) \geq w^* + \delta\left(kf + \sum_{i=0}^{+\infty} \delta^i \overline{w} \right). \qquad \cdots(3)$$

The left-hand sides of WIC-*q* and WIC-*y* indicate the present value of the worker's total payoffs in period *t* in the cooperative phase. The right-hand side of WIC-*q* mentions the present value of the worker's total payoffs when the worker rejects the remuneration package and quits the firm in subperiod t^1. The right-hand side of WIC-*y* indicates the present value of the worker's total payoff when the worker engages in shirking behavior. A shirking worker receives the current basic wage *w** because the worker has already been employed in period *t*. However, the bonus is not paid in subperiod t^3.

As mentioned, in the punishment phase, a firm can choose between two states, firing or dead wood. However, the present value of the worker's total payoff is not affected by the firm's decision in the punishment phase because the firm is willing to offer the minimum basic wage to keep the worker as dead wood.

The two constraints of WIC-*q* and WIC-*y* must be satisfied to prevent the worker from deviation. Since the firm is willing to minimize the remuneration cost, the basic wage *w** should be lower than $\overline{w} + (1-\delta)kf$:

$$w^* \leq \overline{w} + (1-\delta)kf \, . \qquad \ldots(4)$$

In this case, WIC-y is slack as long as WIC-q holds. Thus, WIC-q is binding at the equilibrium:

$$w^* + b^* = \mu + \overline{w} + (1-\delta)kf \, . \qquad \ldots(5)$$

To implement and keep the cooperative phase, the firm is willing to offer the remuneration package (w^*, b^*) satisfying (4) and (5).

2. Incentive conditions of a firm

Next, I consider the incentive compatibilities of the firm to pay the implicit bonus. The firm makes a decision on the bonus after observing the behavior of the worker. Even if the worker produces positive output, the firm can breach the implicit promise on the bonus. It is necessary to check whether the firm is willing to pay the bonus b^* to keep the cooperative phase.

The firm makes a decision on a remuneration package in subperiod t^0 and the bonus payment in subperiod t^3. The firm's incentive compatibilities in period t (= 2, 3,…) are given, respectively, as follows:

$$\text{FIC-}p\text{:} \quad \sum_{i=0}^{+\infty} \delta^i (1 - w^* - b^*) \geq -\min\left\{ f \, , \, kf + \frac{\overline{w}}{1-\delta} \right\}, \qquad \ldots(6)$$

$$\text{FIC-}b\text{ :} \quad \sum_{i=0}^{+\infty} \delta^i (1 - w^* - b^*) \geq 1 - w^* - \delta \min\left\{ f \, , \, kf + \frac{\overline{w}}{1-\delta} \right\}. \qquad \cdots(7)$$

The left-hand side of FIC-p and FIC-b indicates the present value of the firm's total payoffs in the cooperative phase. The right-hand side of FIC-p indicates the firm's payoff when the firm deviates from the equilibrium remuneration package. The outcome depends on the strictness of EPL. In the case of firing, the firm bears the firing cost f. On the other hand, in the case of dead wood, the firm keeps on paying the basic wage in a period equivalent to $\overline{w} + (1-\delta)kf$; thus, the present value of the total wage cost is $kf + \frac{\overline{w}}{1-\delta}$.

The right-hand side of FIC-b is the payoff of the firm when the firm does not pay the bonus b*. The firm can swindle the output, but has to pay the basic wage w*. Then, the punishment phase starts from the next period.

Lemma 2

FIC-p holds as long as FIC-b does.

The Proof is easy and given in the Appendix. FIC-p is slack, and thus I focus only on FIC-b.

3. Equilibrium remuneration package

It is well established by the folk theorem that cooperation between a firm and a worker can be implemented and continued when the discount factor is sufficiently high. By considering the trigger strategies, I can derive the minimum value of the discount factor, $\overline{\delta}$, to sustain the cooperative phase. Higher w* reduces the right-hand side of FIC-b and makes FIC-b less tight. As the right-hand side of FIC-b is smaller, the discount factor for cooperation dwindles. Therefore, the minimum discount factor is derived under the remuneration package by $w^* = \overline{w} + (1-\delta)kf$ and $b^* = \mu$.

Lemma 3

The minimum discount factor for cooperation is given under the remuneration package: $w^* = \overline{w} + (1-\delta)kf$ and $b^* = \mu$.

The implicit bonus is the driving force for the worker's incentive, but is independent of the firing cost. The firing cost influences the basic wage only. Substituting the remuneration package into FIC-b, the minimum discount factor $\overline{\delta}$ is derived. In the case of firing, $\delta \geq \delta_1(k, f)$, FIC-$b$ turns into a quadratic condition: $g(k, f) \equiv \delta^2(1-k)f - \delta\{1-\overline{w}+(1-k)f\} + \mu \leq 0$. Then, we denote a smaller solution of $g(k, f) = 0$ as $\delta_2(k, f)$. Clearly, the quadratic condition holds under $\delta \geq \delta_2(k, f)$; thus, the minimum discount factor for cooperation is given by $\overline{\delta} = \delta_2(k, f)$. Similarly, in the case of dead wood, $\delta < \delta_1(k, f)$, FIC-b becomes a simple condition: $\delta \geq \mu$.

Thus, the minimum discount factor is given by $\overline{\delta} = \mu$. The results are summarized as follows:

Proposition 1

[1] In the case of firing, which occurs under $0 < f \leq \dfrac{\overline{w}}{(1-k)(1-\mu)}$,

$$\overline{\delta} = \delta_2(k,\, f) \equiv \frac{1-\overline{w}+(1-k)f-\sqrt{\{1-\overline{w}+(1-k)f\}^2-4(1-k)f\mu}}{2(1-k)f}.$$

[2] In the case of dead wood, which occurs under $f > \dfrac{\overline{w}}{(1-k)(1-\mu)}$, $\overline{\delta} = \mu$.

[3] In the case of $k = 1$ or $f = 0$, it holds that $\overline{\delta} = \dfrac{\mu}{1-\overline{w}}$.

The Proof is given in the Appendix. The minimum discount factor for cooperation is drawn as the red bold curve shown in figure 2. The case of $k = 1$ or $f = 0$ gives a corner solution. Therefore, attention is given to the interior solution under $0 \leq k < 1$ and $f > 0$ throughout this paper.

4. Effects of EPL

The effect of the firing cost on the minimum discount factor is given as follows:

Proposition 2

[1] In the case of firing, a hike in the firing cost decreases the minimum discount factor for cooperation. An increase in the fraction *k* of the monetary transfer in the firing cost raises the minimum discount factor.
[2] In the case of dead wood, a hike in the firing cost or fraction *k* of the monetary transfer does not affect the minimum discount factor for cooperation.

The Proof is shown in the Appendix. As figure 2 indicates, in the case of firing, the minimum discount factor dwindles as the firing cost increases. This means that the firing cost deters the firm and the worker from deviating. In other words, the firing cost plays a significant role in enforcing the implicit bonus b^* and enhancing cooperation. When the firing cost exceeds the critical level: $f = \frac{\overline{w}}{(1-k)(1-\mu)}$, the firm is willing to maintain the employment relationship even in the punishment phase. In the case of dead wood, a hike in the firing cost does not affect the minimum discount factor for cooperation.

A hike in the firing cost f means an increase in the administrative and negotiation costs of firing. The *ex post* rent of the employment relationship is increased by a hike in the firing cost. Thus, it gives the firm and the worker more incentives to maintain the cooperative relationship. This generates the positive effect and motivation to decrease the minimum discount factor for cooperation. On the other hand, an increase in fraction k of the monetary transfer decreases the administrative cost, which decreases the *ex post* rent of the employment relationship. Thus, it gives a negative effect on their cooperation.

When the firing cost is large, the firm will continue employing the worker as dead wood in the punishment phase; thus, the firm does not bear the large firing cost directly. The firing cost does not influence all of the *ex post* rent of the employment relationship if it exceeds the critical point. While a hike in the firing cost raises the remuneration that the worker can receive, in the case of dead wood, it is just an issue of the distribution of the rent between the firm and the worker. As lemma 3 indicates, the bonus is independent of the firing cost and monetary transfer. Once the employment relationship has been established, the worker can always receive the benefit of the monetary transfer through the basic wage specified by lemma 3. Thus, the firing cost and monetary transfer are not directly associated with behaviors of the firm and the worker when the punishment phase is the case of dead wood.

As mentioned above, a huge firing cost does not influence the minimum value of the discount factor for cooperation once the employment relationship has been established. However, a huge firing cost will have an influence if the relationship has not been established. This is the next issue to consider.

5. Before establishing a relationship

1. Incentive conditions in period 1

I have considered the periods (t = 2, 3,...) after the employment relationship has been established, where the firm bears the firing cost f and the worker receives the monetary transfer kf whenever the worker quits (or is fired by) the firm. In contrast, the firm does not have to bear the firing cost in period 1 when the worker rejects the firm's offer because the employment relationship has yet to be established. The difference is crucial between the *before* and *after* period of establishing the relationship. Now, we return to period 1.

The minimum value of the discount factor $\bar{\delta}$, which sustains mutual cooperation *after* establishing the relationship in period 2 or later, has been shown in proposition 1. It is needed to consider whether the discount factor also satisfies the incentive compatibilities of the worker and the firm *before* establishing the relationship. Unless it did, the employment relationship would not be established or the cooperative phase would not begin in period 1 under the discount factor $\bar{\delta}$; thus, a discount factor higher than $\bar{\delta}$ would be needed to implement cooperation from period 1.

The incentive compatibilities of the worker in subperiod 1^1 and 1^2 are given, respectively, as follows:

$$\text{WIC-1-}q\text{:}\quad w_1^* + b_1^* - \mu + \frac{\delta}{1-\delta}(w^* + b^* - \mu) \geq \frac{\bar{w}}{1-\delta}, \qquad \cdots(8)$$

$$\text{WIC-1-}y\text{:}\quad w_1^* + b_1^* - \mu + \frac{\delta}{1-\delta}(w^* + b^* - \mu) \geq w_1^* + \delta\left(kf + \frac{\bar{w}}{1-\delta}\right). \qquad \cdots(9)$$

When the worker rejects the firm's offer in period 1, the worker receives only the outside wage $\bar{w}$, thereby, as shown on the right-hand side of WIC-1-q, the present value of the total payoff is $\frac{\bar{w}}{1-\delta}$. In contrast, the right-hand side of WIC-1-y (9) is similar, except w_1^* and w^*, to that of WIC-y (3) because the production process has finished and the employment relationship has been established.

If $w_1^* \leq \bar{w} - \delta kf$, WIC-1-$y$ is slack as long as WIC-1-q holds. Since the basic wage w_1^* in period 1 is non-negative, WIC-1-y is slack in the case of $\bar{w} \geq \delta kf$. In this case, using lemma 3, WIC-1-q requires $w_1^* + b_1^* \geq \mu + \bar{w} - \delta kf$. Since the firm is willing to minimize the remuneration, the optimal remuneration package in period 1 is given by

$w_1^* \in [0, \bar{w} - \delta kf]$ and $w_1^* + b_1^* = \mu + \bar{w} - \delta kf$.

Otherwise, in the case of $\bar{w} < \delta kf$, WIC-1-*y* is more crucial than WIC-1-*q* because WIC-1-*q* is slack. From lemma 3, WIC-1-*y* becomes $b_1^* \geq \mu$. The firm is unwilling to pay a positive basic wage in period 1, $w_1^* = 0$. The results are summarized as follows:

Lemma 4

The optimal remuneration package in period 1 is given by

[1] in the case of $\bar{w} \geq \delta kf$, $w_1^* \in [0, \bar{w} - \delta kf]$ and $w_1^* + b_1^* = \mu + \bar{w} - \delta kf$

[2] in the case of $\bar{w} < \delta kf$, $w_1^* = 0$ and $b_1^* = \mu$.

Once the employment relationship has been established, the firm has to incur the firing cost when the worker quits (is fired by) the firm. Thus, the worker has an opportunity to receive the monetary transfer *kf* whenever he quits. The firm must compensate the worker with the transfer to keep the worker employed. The firm and the worker anticipate the situation after the relationship has been established; thus, in period 1, the firm is willing to take back the entire rent that the worker will receive in period 2 or later. The case [1] in lemma 4 means that in period 1 the firm can take all rents, which the worker will receive in period 2 or later, by lowering the remuneration in period 1. On the other hand, in case [2] in lemma 4, the firm can absorb a part of the rent.

The following result is easy to introduce from lemmas 3 and 4:

Proposition 3

[1] In the cooperative phase, the optimal basic wage in period 1 is lower, but in period 2 or later it is higher than the outside wage: $w_1^* < \bar{w} \leq w^*$.

[2] An optimal bonus is equivalent to the effort cost in any period of the cooperative phase: $b_1^* = b^* = \mu$.

Proposition 3 shows that the worker receives the rent through the basic wage in period 2 or later, and that the firm takes back the entire or a part of the rent by lowering the basic wage in period 1. The gap in the basic wage between in periods 1 and 2 or later is given by kf or $(1-\delta)kf$. Therefore, EPL increases the gap in the basic wage before and after establishing the relationship.

2. Minimum discount factor for cooperation

The incentive compatibilities of the firm in period 1 are given by

$$\text{FIC-1-}p\text{:}\quad 1-w_1^*-b_1^*+\frac{\delta}{1-\delta}(1-w^*-b^*)\geq 0,$$

$$\text{FIC-1-}b\text{:}\quad 1-w_1^*-b_1^*+\frac{\delta}{1-\delta}(1-w^*-b^*)\geq 1-w_1^*-\delta\min\left\{f,\ kf+\frac{\overline{w}}{1-\delta}\right\}.$$

We have to deliberate whether the minimum discount factor $\overline{\delta}$ for cooperation from period 2 satisfies FIC-1-*p* and FIC-1-*b*.

When $b_1^*=b^*=\mu$ is offered, FIC-*b* holds if and only if FIC-1-*b* does. This means that FIC-1-*b* always holds as an equality under $\delta=\overline{\delta}$ because FIC-*b* holds as an equality under $\delta=\overline{\delta}$ from the definition of $\overline{\delta}$. Thus, it is sufficient to consider whether the other constraint, FIC-1-*p*, holds under $\delta=\overline{\delta}$. If it holds, the discount factor $\overline{\delta}$ is also the minimum value for cooperation from period 1, which is denoted as δ^*.

Lemma 5

It holds that $\delta^*=\overline{\delta}$ when $1\geq\overline{\delta}\min\left\{f,\ kf+\frac{\overline{w}}{1-\overline{\delta}}\right\}$ does.

The lemma indicates that the minimum discount factor $\overline{\delta}$ for cooperation in period 2 or later, which is specified in proposition 1, satisfies FIC-1-*p* and FIC-1-*b* when the above condition holds. Note that FIC-1-*b* always holds as an equality under $\delta=\overline{\delta}$. When the condition in lemma 5 holds, the right-hand side of FIC-1-*b* is non-negative by offering w_1^*, appropriately. Thus, FIC-1-*p* holds under $\delta=\overline{\delta}$.

Since $\delta \min\left\{ f,\, kf + \frac{\overline{w}}{1-\delta} \right\}$ increases with respect to δ, there is a value of $\hat{\delta}$ such that $\hat{\delta} \min\left\{ f,\, kf + \frac{\overline{w}}{1-\hat{\delta}} \right\} = 1$. Thus, the condition in lemma 5 is replaced as follows:

$$\overline{\delta} \le \hat{\delta}, \text{ where } \hat{\delta} \text{ satisfies } \hat{\delta} \min\left\{ f,\, kf + \frac{\overline{w}}{1-\hat{\delta}} \right\} = 1. \quad \ldots(10)$$

I present a sufficient condition, $\overline{w} \ge \overline{\delta} kf$, under which condition (10) holds. As lemma 4 shows, when $\overline{w} \ge \overline{\delta} kf$ holds, the firm can absorb all of the rent, which the worker will receive in period 2 or later, by lowering the basic wage sufficiently in period 1.[6] The present value of the firm's total profit is equivalent to the total net benefit generated by the employment relationship, $\frac{1-\mu-\overline{w}}{1-\delta}$, which is always positive for any discount factor given in the assumption of the model. Therefore, the minimum discount factor δ^* for cooperation from period 1 is equivalent to the discount factor $\overline{\delta}$ from period 2 or later. The effect of EPL shown in proposition 2 is also applied from period 1.[7]

Finally, I consider the case in which condition (10) does not hold under $\delta = \overline{\delta}$.

Proposition 4

When condition (10) does not hold, the minimum discount factor that sustains mutual cooperation from period 1 is given by

$$\delta^* = \delta_3(k,\, f) \equiv \frac{kf + \overline{w} + \sqrt{(kf + \overline{w})^2 - 4kf(1-\mu)}}{2kf} > \overline{\delta}.$$

---

[6] The condition (10) holds if $\overline{w} \ge \overline{\delta} kf$ does; however, the opposite is not true. Even if the firm cannot absorb all of the worker's rent, FIC-1-*p* may hold under $\delta = \overline{\delta}$.

[7] In this model, the basic wage and bonus have been assumed to be non-negative. Without the assumption of limited liability, firms could take all benefits of workers by sufficiently negative wage offers; thus, the discount factor $\overline{\delta}$ is applied from period 1: $\delta^* = \overline{\delta}$.

The Proof is in the Appendix. When condition (10) does not hold, the discount factor δ^* for cooperation from period 1 is more than $\overline{\delta}$. As the folk theorem shows, a sufficiently high discount factor that satisfies all incentive conditions from period 1 always exists. This case is likely to occur when kf is huge.

Condition (10) indicates that when both k and f are sufficiently large, the discount factor $\overline{\delta}$ does not satisfy the incentive compatibilities of the firm in period 1. When the fraction of monetary transfer, k, is small, the discount factor $\overline{\delta}$ satisfies the incentive compatibilities of the firm in period 1 even if the firing cost f is huge. In fact, as lemma 4 shows, in the case of $k=0$, the firm can take back all of the rent, which the worker receives in period 2 or later. Hence, the minimum discount factor δ^* for cooperation from period 1 is equivalent to $\overline{\delta}$.

3. Effects of EPL

The effect of the firing cost is given as the following proposition:

Proposition 5

[1] When condition (10) does not hold, it holds that $\delta^*=\delta_3(k, f)$. A hike of f or k increases δ^*.

[2] Otherwise, $\delta^*=\overline{\delta}$ holds. The effect of the firing cost is given as shown in proposition 2.

The Proof is in the Appendix. Finally, I consider the effect of the firing cost on the minimum value of the discount factor that sustains mutual cooperation from period 1.

Proposition 6

As the firing cost increases given a particular level of the fraction of monetary transfer, the minimum value of the discount factor δ^* that sustains mutual cooperation from the period 1 decreases first, then increases.

The shape of the minimum discount factor δ^* that sustains mutual cooperation from period 1 is dependent on the parameters, as shown in figures 3 and 4. Regardless of the cases shown in figure 3 or 4, as the firing cost increases, the minimum discount factor δ^* decreases first, then increases.

As the firing cost increases, the *ex post* rent of the employment relationship increases given a particular fraction *k* of the monetary transfer. Thus, it reduces the minimum discount factor for cooperation and makes the firm and the worker more motivated to cooperate. This is the positive effect of EPL to enhance cooperation. However, when the firing cost is huge, the monetary transfer that the worker can receive is large. Thus, the firm has to offer a big remuneration to keep the worker's incentive, which discourages the firm from employing the worker. This is the negative effect, which is likely to appear when the fraction of the monetary transfer is high. The negative effect caused by strict EPL requires a higher discount factor for cooperation. Therefore, as shown in figures 3 and 4, there is an appropriate strictness in EPL in the middle range.

6. Conclusion and Discussion

I have considered the effect of firing costs on the minimum discount factor for cooperation: [1] A hike in the firing cost first decreases the minimum discount factor, and then increases it and [2] A hike in the fraction of the monetary transfer increases the minimum discount factor. These results show that procedural inconveniences such as providing advance notices or negotiations with unions can enhance a cooperative employment relationship as long as they are not strict. In contrast, monetary transfers such as severance pay dampen cooperation because they discourage workers' incentive.

The above results are explained intuitively as follows. The existence of procedural inconveniences increases the *ex post* rent generated by the relationship between a firm and a worker; thus, their motivation for cooperation is enhanced. As a result, the minimum discount factor for cooperation decreases. On the other hand, a hike in the firing cost increases the severance pay that workers receive when they leave their firms. This makes the moral hazard problem of workers more serious; thus, firms are required to pay high remuneration. The effect is negative. As the firing cost increases, the positive effect is likely to be dominated by the negative one; thus, an appropriate level for the firing cost exists in the middle range.

Although I have focused on an employment relationship from a microeconomic perspective, this result is associated with macroeconomic views. From the perspective of macro search models, the effect of EPL has been controversial. When EPL is strict, the effect of EPL is likely to be negative and to worsen unemployment rates. However, when EPL is moderate, it is not always negative. A similar result is obtained from both macroeconomic and microeconomic perspectives.

In this paper, the subgame perfect Nash equilibrium under the trigger strategies has been considered. Although it has the virtue of being simple to analyze, the possibility of renegotiation is ignored. An optimal punishment scheme is also beyond the focus of this paper, but infinitely repeated punishment seems to be unrealistic. However, it is not essential to the results. Suppose that the punishment phase continues for a particular s (≥ 1) period. Even if they deviate from the cooperative phase, they can return from the punishment phase in s periods. As s increases, punishment is severe, and, thus, the minimum discount factor for cooperation decreases. As long as s is positive, that is, the punishment phase exists, the results in this paper hold. Clearly, when the punishment phase continues infinitely, the minimum discount factor for cooperation is minimized.[8]

The above situation, in which firms and workers can return to the cooperative phase from the punishment one, is also associated with the macroeconomic search model. In the Mortensen- and Pissarides-type search model, firms and workers can find new partners from the unemployment pool. Although I have not considered the macroeconomic search mechanism, the main result of this study is consistent with those of the macroeconomic perspectives and is not much influenced by the assumption of the trigger strategies.

8 This is the principle of Abreu (1988).

Appendix

Proof of lemma 1

A firm and a worker play their trigger strategies in period t ($t = 2, 3, \ldots$).

[1] The best response of the worker to the firm in the punishment phase is as follows:

- In subperiod t^2, the worker will not produce positive output given the history of $h(t^2) \neq (a_1^*, a^*, \ldots, a^*, \{(w^*, b^*), 1\})$ because the worker realizes that he cannot receive any bonus, and that his payoff is not influenced hereafter by generating high output.
- In subperiod t^1, the worker will remain in the firm, $q_t = 1$, if the basic wage offer is equivalent to or more than his alternative payoff, $\bar{w} + (1-\delta)kf$. He gets the monetary transfer kf in the incumbent period and the outside wage $\bar{w}$ hereafter if he quits; thus, his average payoff in a period is given by $\bar{w} + (1-\delta)kf$. If the firm pays the basic wage or a higher wage, it is more optimal for the worker to remain than to quit. Otherwise, the worker will quit the firm, $q_t = 0$.

Therefore, the trigger strategy of the worker is the best response to the firm in the punishment phase.

[2] The best response of the firm to the worker in the punishment phase is as follows:

- In subperiod t^3, zero bonus payment, $b_t = 0$, is optimal for the firm given the history of $h(t^3) \neq (a_1^*, a^*, \ldots, a^*, \{(w^*, b^*), 1, 1\})$ because a positive bonus does not induce the worker to produce positive output hereafter.
- In subperiod t^0, given the history of $h(t^0) \neq (a_1^*, a^*, \ldots, a^*)$, the firm anticipates that no output is produced by the worker. In the case of $\delta \geq \delta_1(k, f)$, the zero remuneration package $(w_t, b_t) = (0, 0)$ is optimal for the firm to induce the worker to quit. In the other case of $\delta < \delta_1(k, f)$, the firm will avoid breaking off the employment relationship; thus, the remuneration package $(w_t, b_t) = (\bar{w} + (1-\delta)kf, 0)$ is optimal. The basic wage is the minimum payment to maintain the relationship.

Therefore, the trigger strategy of the firm is the best response to the worker in the punishment phase.

Accordingly, the outcome of a period t in the punishment phase is $a_t = \{(0, 0), 0, 0, 0\}$ in the case of $\delta \geq \delta_1(k, f)$ or $a_t = \{(\bar{w} + (1-\delta)kf, 0), 1, 0, 0\}$ in the case of $\delta < \delta_1(k, f)$. ■

Proof of lemma 2

FIC-b is written as follows: $-b^* + \frac{\delta}{1-\delta}(1 - w^* - b^*) \geq -\delta \min\left\{f, kf + \frac{\bar{w}}{1-\delta}\right\}$. Thus, it holds that

$$\frac{1}{1-\delta}(1 - w^* - b^*) \geq -\min\left\{f, kf + \frac{\bar{w}}{1-\delta}\right\} + \frac{b^*}{\delta} \geq -\min\left\{f, kf + \frac{\bar{w}}{1-\delta}\right\}.$$

This indicates that FIC-p always holds as long as FIC-b does. ■

Proof of proposition 1

[1] In the case of $\delta \geq \delta_1(k, f)$, FIC-$b$ becomes $(1 - w^* - b^*) \geq (1-\delta)(1 - w^*) - \delta(1-\delta)f$.

Substituting the remuneration package specified by lemma 3, it holds that

$$g(k, f) \equiv \delta^2(1-k)f - \delta\{1 - \bar{w} + (1-k)f\} + \mu \leq 0. \qquad \text{…(A1)}$$

Note that in the case of $\delta = 1$, it holds that $g(k, f) = -1 + \mu + \bar{w} < 0$.

In the case of $k \neq 1$ and $f \neq 0$, (A1) becomes a second-order inequality with respect to δ. Then, I denote a smaller solution of $g(k, f) = 0$ as $\delta_2(k, f)$:

$$\delta_2(k, f) \equiv \frac{1-\overline{w}+(1-k)f-\sqrt{\{1-\overline{w}+(1-k)f\}^2-4(1-k)f\mu}}{2(1-k)f}.$$

Thus, when $\delta \geq \delta_2(k, f)$, the inequality (A1) holds as shown in figure A-1. The minimum value of the discount factor is given by $\overline{\delta} = \delta_2(k, f)$. In addition, $\delta_2(k, f)$ must satisfy $\delta_2(k, f) \geq \delta_1(k, f) \equiv 1-\frac{\overline{w}}{(1-k)f}$. The range is $0 < f \leq \frac{\overline{w}}{(1-k)(1-\mu)}$.

[2] Similarly, in the case of $\delta < \delta_1(k, f)$, FIC-*b* turns to $(1-w^*-b^*) \geq (1-\delta)(1-w^*)-\delta(1-\delta)kf-\delta\overline{w}$. Substituting the remuneration package specified by lemma 3, it is obtained that $\delta \geq \mu$. Thus, the minimum value of the discount factor is given by $\overline{\delta} = \mu$. In addition, it must satisfy $\mu < \delta_1(k, f)$. Thus, the range is $f > \frac{\overline{w}}{(1-k)(1-\mu)}$.

[3] In the case of $k=1$ and $f=0$, (A1) turns to $\delta \geq \frac{\mu}{1-\overline{w}}$. Thus, the minimum discount factor is given by $\overline{\delta} = \frac{\mu}{1-\overline{w}}$. ■

Proof of proposition 2

[1] In the case of $\delta \geq \delta_1(k, f)$, differentiating $g(k, f)$ with the firing cost *f*: $\frac{\partial g(k, f)}{\partial f} = -\delta(1-\delta)(1-k) < 0$. This means that the smaller solution of $g(k, f) = 0$ is reduced by a hike of f.

Next, differentiating $g(k, f)$ with respect to *k*, $\frac{\partial g(k, f)}{\partial k} = \delta f(1-\delta) > 0$. This indicates that the smaller solution of $g(k, f) = 0$ is raised by an increase of the fraction of the monetary transfer.

[2] In the case of $\delta < \delta_1(k, f)$, the minimum discount factor $\overline{\delta}$ is equivalent to μ.

Thus, it is not affected by a hike of *f* or *k*. ■

Proof of proposition 4

When the condition (10) does not hold, FIC-1-*p* does not hold under $\delta = \overline{\delta}$. In this case, $\overline{w} < \overline{\delta} kf$ holds. Thus, as lemma 4 shows, the optimal remuneration package in the period 1 is $(w_1^*, b_1^*) = (0, \mu)$. Substituting the remuneration packages (w_1^*, b_1^*) and (w*, b*) shown in lemma 3 into FIC-1-*p*, the following inequality is derived:

$$h(k, f) \equiv \delta^2 kf - \delta(kf + \overline{w}) + 1 - \mu \geq 0. \qquad \ldots\text{(A2)}$$

Under $\delta = 1$, (A2) becomes $h(k, f) = 1 - \mu - \overline{w} > 0$; thus, (A2) holds. Then, I denote a larger solution of $h(k, f) = 0$ as $\delta_3(k, f)$, where

$$\delta_3(k, f) \equiv \frac{kf + \overline{w} + \sqrt{(kf + \overline{w})^2 - 4kf(1-\mu)}}{2kf}.$$

Therefore, when $\delta \geq \delta_3(k, f)$, (A2) holds (figure A-2). The minimum discount factor for cooperation from period 1 is given by $\delta^* = \delta_3(k, f)$. ■

Proof of proposition 5

Differentiating $h(k, f)$ with respect to *f*, $\dfrac{\partial h(k, f)}{\partial f} = -\delta k(1-\delta) < 0$. This indicates that $\delta_3(k, f)$ increases with respect to *f*. Similarly, differentiating $h(k, f)$ with respect to *k*, $\dfrac{\partial h(k, f)}{\partial k} = -\delta f(1-\delta) < 0$. Thus, $\delta_3(k, f)$ increases with respect to *k*. ■

References

Abreu, Dilip (1988) "On the Theory of Infinitely Repeated Games with Discounting," *Econometrica*, vol. 56, 383-396.

Aghion, Philippe; Algan, Yann; Cahuc, Pierre; and Shleifer, Andrei (2010) "Regulation and Distrust," *Quarterly Journal of Economics*, vol. 125, 1015-1049.

Aghion, Philippe; Algan, Yann; and Cahuc, Pierre (2011) "Civil Society and the State: the Interplay between Cooperation and Minimum Wage Regulation," *Journal of the European Economic Association*, vol. 9, 3-42.

Baker, George (1992) "Incentive Contracts and Performance Measurement," *Journal of Political Economy*, vol. 100, 598-614.

Baker, George (2002) "Distortion and Risk in Optimal Incentive Contracts," *Journal of Human Resources*, vol. 37, 728-751.

Baker, George; Gibbons, Robert; and Murphy, Kevin J. (1994) "Subjective Performance Measures in Optimal Incentive Contracts," *Quarterly Journal of Economics*, vol. 109, 1125-1156.

Belot, Michele; Jan, Boone; and Jan C. van Ours (2007) "Welfare-Improving Employment Protection," *Economica*, vol. 74, 381-396.

Bertola, Giuseppe; Tito, Boeri; and Sandrine, Cazes (2000) "Employment Protection in Industrialized Countries: The Case for New Indicators," *International Labour Review*, vol. 139, 57-72.

Blanchard, Oliver and Philippon, Thomas (2006) "The Quality of Labor Relations and Unemployment," *NYU Working Paper*, No. FIN-06-038.

Brown, Charles (1990) "Firm's Choice of Method of Pay," *Industrial and Labor Relations Review*, vol. 43, 165-182-S.

Bull, Clive (1987) "The Existence of Self-enforcing Implicit Contracts," *Quarterly Journal of Economics*, vol. 102, 147-159.

Demougin, Dominique and Carsten, Helm (2011) "Job matching when employment contracts suffer from moral hazard," *European Economic Review*, forthcoming.

Fella, Giulio (2000) "Efficiency Wage and Efficient Redundancy Pay," *European Economic Review*, vol. 44, 1473-1490.

Galdon-Sanchez, Jose E. and Maia, Guell (2003) "Dismissal Conflicts and Unemployment," *European Economic Review*, vol. 47, 323-335.

Holmstrom, Bengt and Paul, Milgrom (1991) "Multitask principal-Agent Analysis:

Incentive Contracts, Asset Ownership, and Job Design,” *Journal of Law, Economics and Organization*, 7, 24-52.

Levin, Jonathan (2003) “Relational Incentive Contracts,” *American Economic Review*, vol. 93, 835-857.

Macleod, W. Bentley and Malcomson, James M. (1989) “Implicit Contracts, Incentive Compatibility, and Involuntary Unemployment,” *Econometrica*, vol. 57, 447-480.

Shapiro, Carl and Joseph, Stiglitz (1984) “Equilibrium Unemployment as a Discipline Device,” *American Economic Review,* vol. 74, 433-444.

Suedekum, Jens and Peter, Ruehmann (2003) “Severance Payments and Firm-Specific Human Capital,” *Labour*, vol. 17, 47-62.

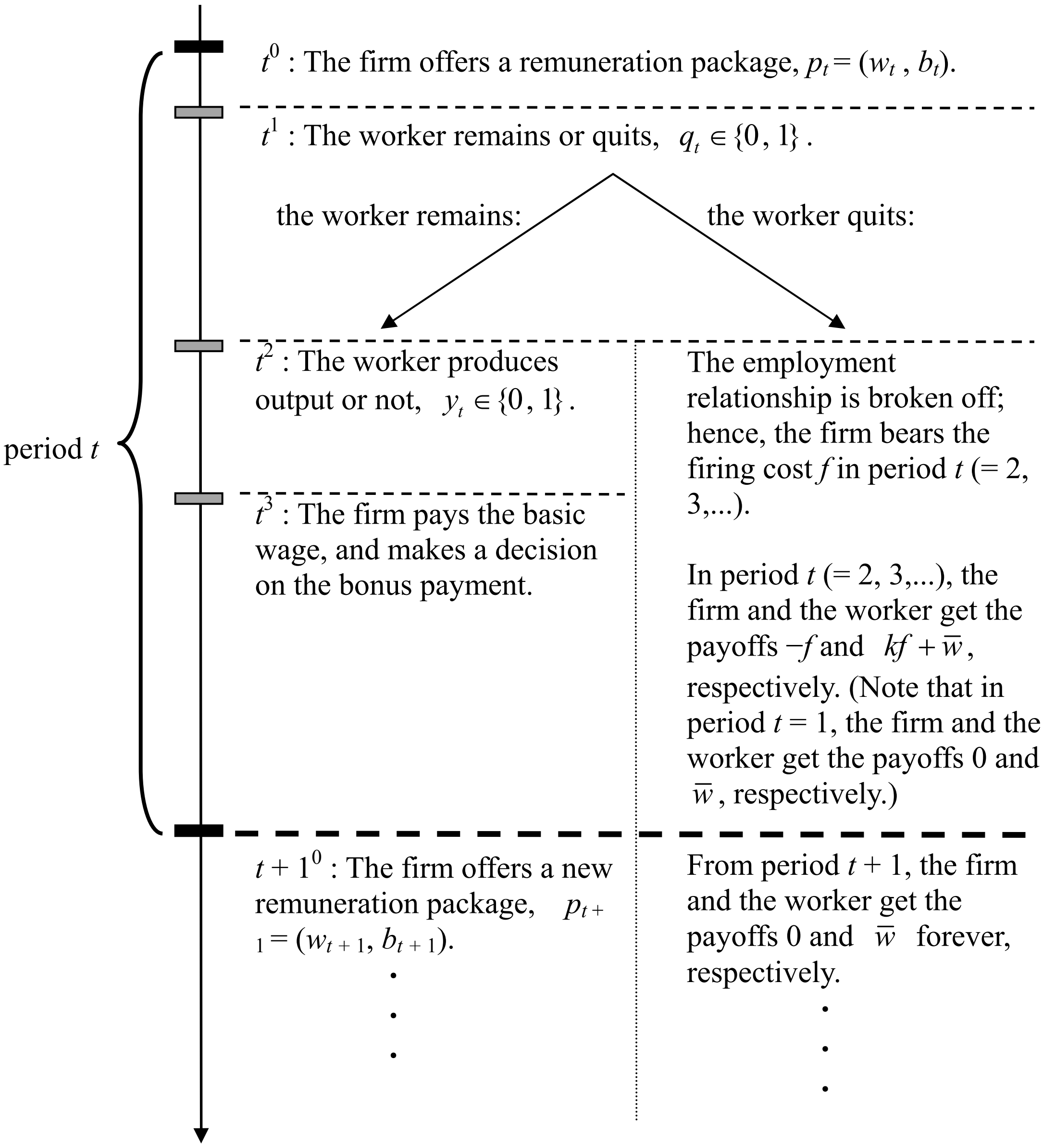

Figure 1

Timing of behaviors

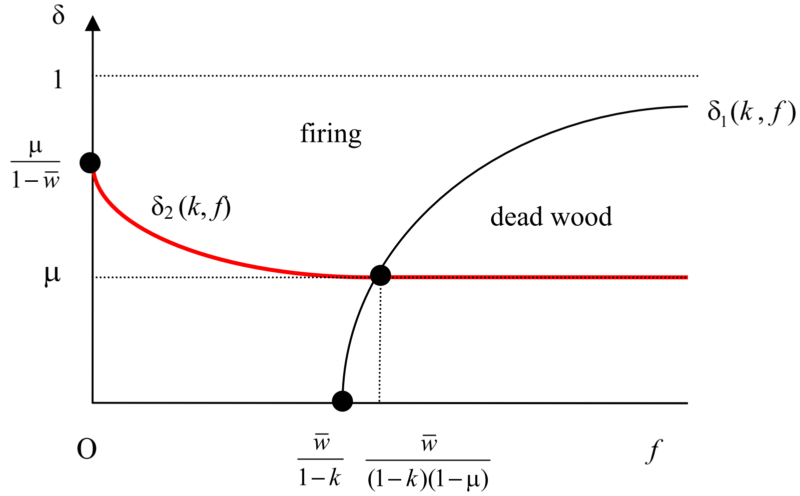

Figure 2

In a period t (= 2, 3,…), the red curve indicates the minimum discount factor for mutual cooperation under the trigger strategies of the firm and the worker. In the case of $\delta < \delta_1(k, f)$, the worker remains as dead wood in the firm in the punishment phase. In the case of $\delta \geq \delta_1(k, f)$, the worker quits (is fired by) the firm in the punishment phase.

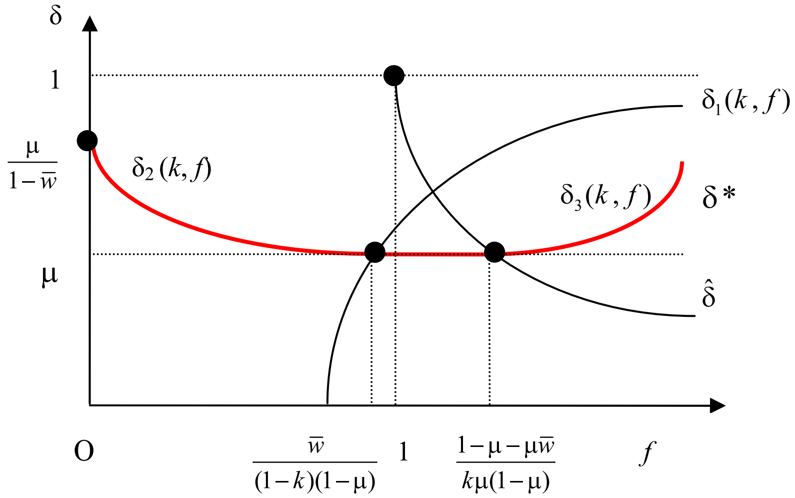

Figure 3

A case of the minimum discount factor $\delta*$ for cooperation represented by the red bold curve

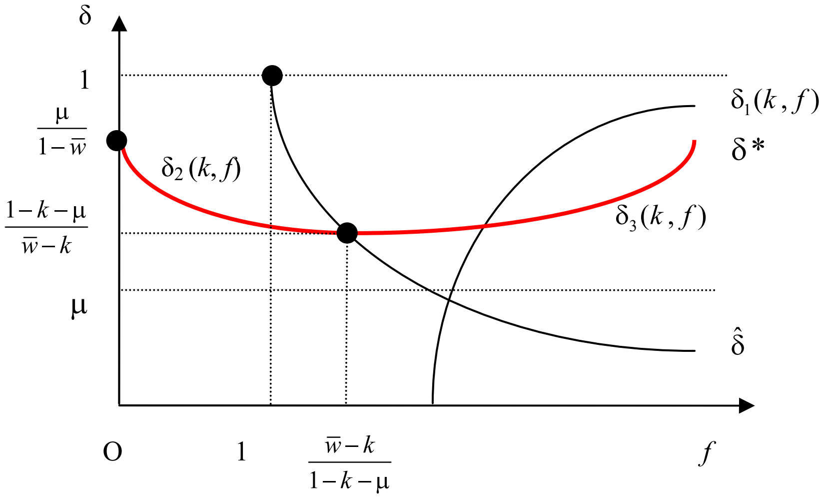

Figure 4

Another case of the minimum discount factor δ^* for cooperation represented by the red bold curve

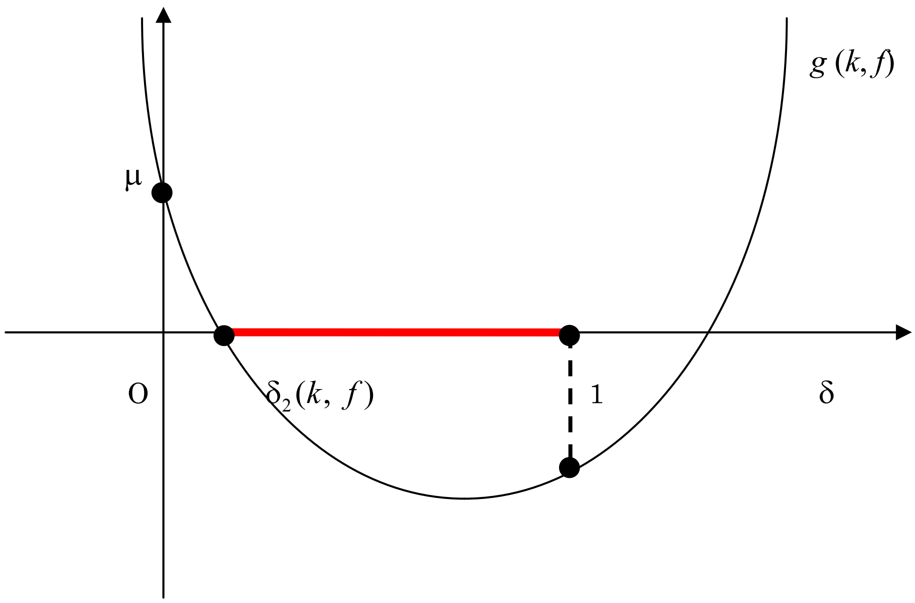

Figure A-1
The curve of $g\ (k, f)$

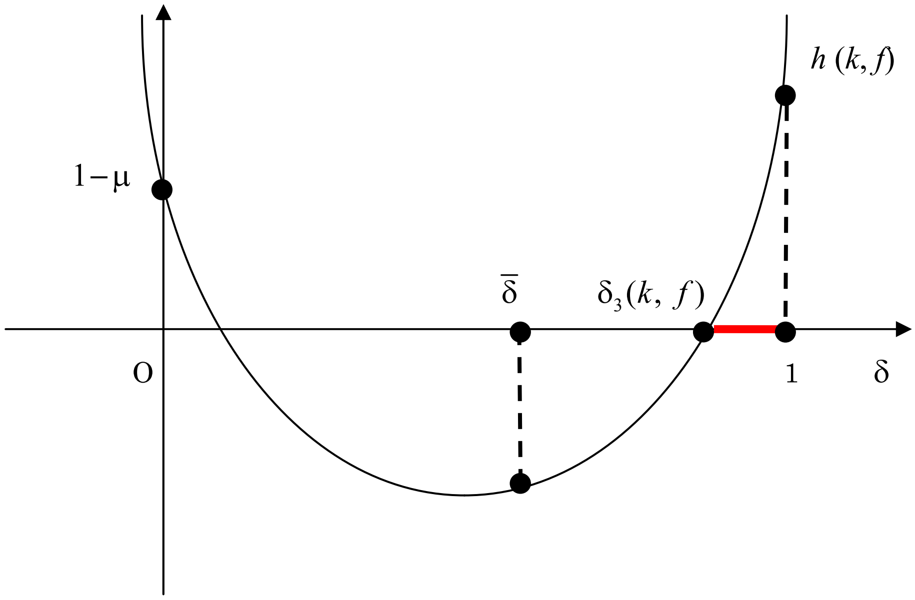

Figure A-2

The curve of $h\ (k, f)$