Employment Protection and Incentives:
Severance Pay vs. Procedural Inconvenience *

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Abstract
I consider the effects of employment protection (EP) on worker incentives and the labor market with search friction. I categorize EP into severance pay and procedural inconvenience. Severance pay is merely a transfer of money from firms to fired workers, while procedural inconvenience yields a wasteful cost. This difference is crucial to worker incentives when severance pay is a benefit for shirking workers. Although it appears to negatively affect worker incentives, EP, particularly procedural inconvenience, has a positive effect on incentives if EP is not severe. An optimal balance exists between severance pay and procedural inconvenience.

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1. Introduction

There have been numerous studies focused on the effects of employment protection (EP) on the economy with conflicting results regarding crucial factors such as unemployment rate and social welfare. The effect that EP has on worker incentives has also been somewhat ambiguous. EP is often assumed to negatively affect worker incentives as represented by the efficiency wage model in which the threat of dismissal is a driving force in worker incentives; if shirking workers are unlikely to be fired because of EP provisions, EP has a disincentive effect.

Although the disincentive effect of EP is crucial, EP also may have a positive effect on worker incentives. Even a diligent worker may have some subpar performance, or his/her firm may be in very poor state during weak economic situations, resulting in uncertainty about the firm’s ability to maintain the employment relationship. Workers making credible efforts for their firms realize they cannot recover the cost of their efforts if they can be easily fired due to unfavorable business conditions. Because a firm’s decision regarding the dismissal of workers tends to be myopic, credible job security should be provided through social institutions. A significant function of EP is to provide a commitment device for job security. This is a commitment effect of EP. The objective of this paper is to consider the effects of EP on the incentives for workers and the labor market with search friction and to analyze whether the commitment effect overrides the disincentive effect.

While the disincentive effect of EP is more often discussed, the commitment effect has generally not been given serious consideration except in some recent studies regarding skill formation. Suedekum and Ruehmann (2003) and Belot, Boone, and van Ours (2007) indicate that the introduction of severance pay as a type of EP encourages workers to make a human investment because severance pay gives workers some of the rent that induces skill formation. Booth and Zoega (2003) suggest that firing policies tend to be excessively implemented because firms are not concerned about the human capital lost when workers quit and move to other industries.\(^1\)

Although previous studies generated insightful results, they are limited to partial equilibrium models. Therefore, they exclude the effects of EP on firms’ entry level in terms of the general equilibrium. Similar to a recent study by Demougin and Helm (2011), who analyzed an incentive problem from the perspective of the search

\(^{1}\) Some studies show that unions function as commitment devices: Booth and Chatterji (1998) show that unions’ bargaining power enhances skill formation and improves social welfare; Eguchi (2002) also points out the significance of unions as commitment devices for job security. Piccirilli (2010) analyzes the effect of employment protection when unions can commit future wages.
model, I use the general search equilibrium model to focus on incentive problems of workers, rather than on skill formation. I look at the effects of EP on the incentives of workers and the labor market with search friction, in particular, wage level, the likelihood of firing, the unemployment rate, inflows and outflows of unemployment, and social welfare. Furthermore, I also consider the effects of EP under short- or long-term economic shocks.

In the literature, EP has been treated as a cost that firms incur upon firing workers. I follow this way but categorize firing costs into severance pay (SP) and procedural inconvenience (PI). Although both increase the cost of firing for firms, there is a difference between them. SP is merely the transfer of money from a firm to a fired worker, while PI, which may include providing sufficient advance notice or negotiations with a union, leads to a transaction cost. In that regard, it seems that SP is the better option rather than PI. However, SP can be a benefit for shirking workers and may damage worker incentives. This difference is significant, and I compare the effects of both SP and PI and show an optimal balance between them.

Whether there is a punishment scheme or a monitoring device in place is another important issue because punishment schemes for shirking employees are critical with regard to their incentives. In the context of EP, one crucial issue is whether shirking workers are eligible for SP or protected by EP.

When EP provides benefits only for diligent employees, it is unlikely to cause a negative effect on worker incentives because only diligent employees are protected, the shirking ones are not. In this case, monitoring devices work effectively and firms can verify the shirkers, thus the negative effect of EP on incentives is unlikely to appear. This is a reason why Boeri and Jimeno (2005) indicate that small companies where shirkers can be easily identified can be exempt from EP. Fella (2000), who compares SP with PI by using the efficiency wage model with a monitoring device, thus concludes that SP generates a positive effect when the monitoring device functions effectively.

My purpose, however, is to consider a situation in which no monitoring device is available and all fired employees are protected by EP and can receive SP. In this situation, EP is expected to be the cause of worker moral hazard; however, it will be shown that EP can generate a positive impact on worker incentives and the economy through the commitment effect.2 According to the computer simulation in this paper,

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2 Galdon-Sanchez and Guell (2003) focus on the situation in which the court is unable to distinguish who is a shirker. In their model, firms allege that workers have been fired for their shirking behavior even if they do not shirk. Hence, the fired workers do not receive SP because of the firms’ moral hazard. In the situation where firms’ moral hazard regarding firings is pervasive, some regulations that inhibit firms from easily firing workers are likely to provide positive effects on the economy.
the negative effect of SP is likely to be apparent. In contrast, PI intensifies the commitment effect encouraging workers to work hard, and it improves social welfare. If credible job security is provided to a worker through PI, a firm can lower his/her wage in exchange for higher job security, which reduces the unemployment rate. The positive effect of PI is associated with the level of SP, thus an optimal balance exists between SP and PI.

The result of this numerical illustration indicates that an extensive relaxation in EP provisions, as well as very rigorous EP, inflicts damage on worker incentives indicating there is an optimal level of EP. This result is also similar to studies showing the positive effect of a firing tax without explicit concerns regarding worker incentives, such as Ljungqvist and Sargent (1998) (2007), Rogerson and Schindler (2002), Pissarides (2001), and Blanchard and Tirole (2008).

This paper is organized as follows. Section 2 presents a Mortensen–Pissarides matching model with an incentive problem and considers the effects of SP and PI as EP categories. I also conduct a computer simulation in Section 3 to investigate the effects of SP and PI. Finally, Section 4 presents the conclusions.

2. The Model

1. Employment contract

A firm with a job vacancy is randomly matched to an unemployed worker in the labor market. After matching, the employed worker is required to make an effort to achieve high productivity, and the effort cost $c$ is borne by the worker. However, a firm cannot observe whether a worker makes an effort, but only his/her productivity. Productivity $p$ of a worker who made an effort is stochastically distributed over the range of $p \in [0, +\infty)$. The density and distribution functions are denoted as $\phi(p)$ and $\Phi(p)$, respectively. When a worker shirks, the density and distribution functions are similarly given by $\phi^s(p)$ and $\Phi^s(p)$, respectively. The effort cost of a shirking worker is zero. It is assumed that the first-order stochastic dominance holds, i.e., $\Phi(p) \leq \Phi^s(p)$ for any $p$, with strict inequality for a set of values of $p$ with possible probability. This indicates that high productivity is more likely to be realized when a worker makes an effort than when he/she shirks.

Although I consider a similar situation in which the court makes no distinction between diligent workers and shirking ones, I focus on the worker moral hazard. Firms have to pay SP to all fired workers, including shirking workers.
A wage is specified when a firm is matched to a worker. The wage is not conditional on either the worker’s behavior or his/her productivity $p$; a firm offers just a basic wage. This means that a firm cannot give an incentive to a worker through a performance-based wage scheme like a piece rate. This setting is similar to the Shapiro and Stiglitz (1984) efficiency wage model.

The timing of the actions of a worker and a firm is as follows:

1. When a firm is matched to a worker in the labor market, a wage $w$ is specified.
2. The worker chooses whether or not to make an effort.
3. Productivity $p$ of the worker is observed.
4. The firm makes a decision regarding dismissal after the revelation of productivity $p$, but before producing output. If the worker is fired, he/she receives SP, is transferred to the unemployment pool, and receives the reservation wage $\bar{w}$. Otherwise, he/she produces output of value $p$ and receives the wage $w$.
5. In the next period, the fired worker and the firm that dissolved the match search for a new job match in the labor market. On the other hand, if both the worker and the firm maintain the match, they repeat the same process: A new wage is specified, the worker chooses whether or not to make an effort, and then the value of his/her productivity is stochastically determined. Productivity in each period is independent of those in past periods.

In this model, a wage is specified in the beginning of each period. Once it has been determined, it is inflexible during the incumbent period regardless of the worker's productivity. Then, with the next period, a new wage is determined. In this respect, wages are flexible in the beginning of each period, but inflexible during a period.

2. Employment protection

When a firm fires a worker, the firm bears firing cost $f$. When $p$ is revealed, the firm’s current profit is either $p - w$ if the firm maintains the match, or $-f$ if the firm fires the worker.

Firing cost $f$, borne by the firm, consists of two factors, $s$ and $z$, given as $f = s + z$, where $s$ denotes a monetary transfer such as SP, and $z$ denotes PI such as administrative costs for notification and certification or negotiation with unions. PI is a socially wasteful transaction cost. SP is always given to all fired workers, including shirkers. SP and PI are social rules and are exogenously determined by the government.\(^3\)

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\(^3\) Although SP is a lump-sum transfer in this paper, there are studies on the effect of SP proportional
3. Matching technology

The Mortensen-Pissarides-type matching function is given by \( m = m(u, v) \), where \( u \) is the unemployment rate and \( v \) is the vacancy rate, denoted as the number of vacant jobs as a fraction of the labor force. The vacancy-unemployment ratio \( v/u \) or \( v-u \) ratio, indicating market tightness, is denoted as \( \theta \). The matching function is assumed to be a constant return to scale, that is, \( q(\theta) = m\left(\frac{u}{v}, 1\right) \), where \( q(\theta) \) denotes the probability with which a job vacancy will be matched to an unemployed worker. Clearly, \( q'(0) \leq 0 \). Similarly, the probability with which an unemployed worker will be matched to a job vacancy is given by \( \theta q(\theta) \).

In the labor market, all unemployed workers are considered identical regardless of their past behaviors, because their past behaviors are not observed. Hence, the matching probability is equivalent among the unemployed. Similarly, all job vacancies in the market are identical for the unemployed.

4. Incentive compatibility

As I show later, a worker is fired when his/her productivity is less than a threshold denoted as \( \hat{p} \), which is endogenously determined. A diligent worker who makes an effort is fired with probability \( \Phi(\hat{p}) \). A diligent worker fired for low productivity receives SP from the firm and is transferred to the unemployment pool. That worker’s expected payoff in a current period is given by \( \Phi(\hat{p})(s + \bar{w}) + (1 - \Phi(\hat{p}))w - c \). A shirking worker is fired with probability \( \Phi^S(\hat{p}) \). The expected current payoff is \( \Phi^S(\hat{p})(s + \bar{w}) + (1 - \Phi^S(\hat{p}))w \).

The present discounted value of the payoff of a diligent or shirking worker is denoted as \( E^N \) or \( E^S \), respectively. I consider a discrete-time model; thus, the present discounted value of a diligent worker's payoff is given as

\[
E^N = \Phi(\hat{p})(s + \bar{w}) + (1 - \Phi(\hat{p}))w - c + \frac{1}{1 + r} \left\{ \Phi(\hat{p})U + (1 - \Phi(\hat{p}))E^N \right\}, \quad ...(1)
\]

where \( r \) is the time preference rate, and \( U \) is the present discounted value of the payoff to wages. Staffolani (2002) analyzes a case in which SP is related to wages in the Shapiro–Stiglitz efficiency wage model and shows that an increase in SP is likely to increase employment when that increase in SP reduces wages. Goerke (2006) compares a lump-sum type of SP with an earnings-related type of SP regarding employment level and points out that a lump-sum type of SP has a larger effect on increasing employment level than an earnings-related type.
to the unemployed.\footnote{In this model, a firm and a worker cannot commit to a long-term contract and a wage is determined in the beginning of each period, so that, in general, the wage can be different in each period. However, their past behaviors have sunk and do not influence their current and future behaviors in this model. The worker's productivity is also identically and independently distributed in each period. Thus, the firm and the worker can anticipate that the same things are repeated and the wage offered is equivalent in each period at an equilibrium. Therefore, the recursive dynamic model can be solved by the players.} Similarly, the present discounted value of a shirking worker's payoff is given by

\[ E^S = \Phi^S(\hat{\rho})(s + \bar{w}) + (1 - \Phi^S(\hat{\rho}))w + \frac{1}{1 + r}\left\{\Phi^S(\hat{\rho})U + (1 - \Phi^S(\hat{\rho}))E^S\right\}. \]...(2)

Finally, the present discounted value of the unemployed is given as

\[ U = \bar{w} + \frac{1}{1 + r}\left\{\theta q(\theta)E + (1 - \theta q(\theta))U\right\}, \]...(3)

where \( E = \max\{E^N, E^S\} \).

Incentive compatibility (IC) and individual rationality (IR) are given by \( E^N \geq E^S \) and \( E \geq U \), respectively. To satisfy both, wage \( w \) should be more than the reservation wage \( \bar{w} \), otherwise, no worker would be willing to search for a new job. It holds from \( w > \bar{w} \) that \( E^S > U \), because a shirker receives a higher wage \( w \) upon remaining at the firm or the reservation wage \( \bar{w} \) and severance pay \( s \) upon being fired. This indicates that \( E \geq U \) always holds, thus IR is slack, provided \( E^N \geq E^S \) holds. Therefore, it is sufficient to focus on the incentive compatibility \( E^N \geq E^S \). The following condition is derived on the basis of \( E^N \geq E^S \) and \( E \geq U \):

\[ IC(w, \theta) = \left(\frac{(r + \theta q(\theta) + 1)(w - \bar{w}) - (r + \theta q(\theta))s}{r + \theta q(\theta) + \Phi^S(\hat{\rho})}\right)(\Phi^S(\hat{\rho}) - \Phi(\hat{\rho})) \geq c. \]...(4)

When constraint (4) is satisfied, both IC and IR hold. An individual firm is too small to affect market tightness, thus an individual firm is willing to minimize a wage given a level of market tightness. Constraint (4) is binding at an equilibrium.

\section*{5. Dismissal}

Next, we consider the payoff of a firm. The present discounted value \( J \) of a firm matched to a worker is as follows:
The present discounted value $V$ of a job vacancy is

$$V = -k + \frac{1}{1+r} \{q(0)J + (1-q(0))V\},$$

where $k$ is the job vacancy cost. From the free entry and exit condition on job vacancies, $V = 0$. Hence, it holds that $J = \frac{(1+r)k}{q(0)}$. Further, $\bar{J}$ is defined as $\bar{J} = \frac{J}{1+r}$; thus,

$$\bar{J} = \frac{1}{r + \Phi(\hat{p})} \{\int_{\hat{p}} (p-w)\phi(p)dp - \Phi(\hat{p})f\} \left(\frac{k}{q(0)}\right). \quad \text{...(5)}$$

If a firm fires a worker, the present discounted profit is $-f + V/(1+r) = -f$ given that $V = 0$. On the other hand, if the firm maintains the match, the present discounted profit is given by $p - w + \bar{J} = p - w + \frac{k}{q(0)}$. Hence, the threshold of dismissal is given by

$$\hat{p} = w - f - \frac{k}{q(0)}. \quad \text{...(6)}$$

When the worker's productivity is over $\hat{p}$, the firm is willing to keep the match. Otherwise, the firm fires the worker. The threshold depends on the wage and the firing cost. A decrease in the wage or increase in the firing cost reduces threshold $\hat{p}$.

Although the threshold is determined after the wage has been specified and the effort cost has been sunk, the worker and the firm can anticipate threshold $\hat{p}$ upon being matched. The firm, therefore, minimizes the wage subject to constraint (4) and threshold (6) by using backward induction.

Threshold $\hat{p}$ must be positive to maintain the worker's incentive, i.e., $\hat{p} > 0$. If $\hat{p} = 0$ holds, a worker is never fired, and constraint (4) on incentives is never satisfied. The absence of the threat of dismissal motivates an employee to shirk. This is the common result of the efficiency wage model.\(^5\)

\(^5\) Even a shirking worker can produce positive output in this model, although the likelihood of high productivity is low, and a firm may have no incentive to offer the incentive-compatible wage. Thus, we need to confirm whether a firm is willing to give an incentive to a worker. Suppose that while one firm deviates from the incentive-compatible wage offer at an equilibrium, the others continue to offer the incentive-compatible wage. The firm deviating from the equilibrium will offer a wage, $w^S = \bar{w} + s$. The wage offered is the minimum value of employing a worker. If the wage offered is strictly less than $\bar{w} + s$, workers are willing to quit the incumbent firm, and receive the severance
6. Beveridge curve

The job creation rate is \( \theta q(0) \frac{u}{1-u} \), and the job destruction rate is \( \Phi(\hat{p}) \).

From the steady state condition, in terms of job flow, the job creation rate should be equivalent to the job destruction rate. Thus, the equilibrium unemployment rate is given as a Beveridge curve:

\[
u = \frac{\Phi(\hat{p})}{\Phi(\hat{p}) + \theta q(0)}.
\]

…(7)

7. Search equilibrium

A search equilibrium \((\theta, w)\) is characterized by constraint (4) and the zero profit condition of vacancy (5) along with threshold (6). The following condition holds at an equilibrium.

Lemma 1

It holds at an equilibrium that \( IC_w \frac{\partial IC(w)}{\partial \theta} - IC_w \bar{J}_w < 0 \), where \( IC_w \equiv \frac{\partial IC(w)}{\partial w} \), \( IC_w \equiv \frac{\partial IC(w)}{\partial \theta} \), and \( \bar{J}_w \equiv \frac{\partial \bar{J}}{\partial w} \).

An equilibrium exists at the intersection of the IC and JC curves in Figure 1a, where the IC curve shows constraint (4) with equality: \( IC(w, \theta) = c \); and the JC curve shows the present discounted value of the firm's profit (5): \( JC(w, \theta) = \frac{\bar{J} - k}{q(0)} = 0 \). Lemma 1 pay \( s \) and the reservation wage \( \bar{w} \) in the labor market. In this case, the worker does not make an effort, so the expected current profit of the firm is given by \( \pi^e = -\Phi^\hat{p}(\hat{p}^e) f + \int_{\hat{p}} (p - w^e)\psi(p)dp \), where \( \hat{p}^e \equiv w^e - f - \frac{k}{q(0)} \). Note that the equilibrium market tightness is barely influenced by a single firm that is too small.

On the other hand, if the firm offers the incentive-compatible wage, as described in the text, the expected current profit is given as \( \pi = -\Phi(\hat{p}) f + \int_{\hat{p}} (p - w)\psi(p)dp \). Using (5), it holds at the equilibrium that \( \pi = \frac{k(r + \Phi(\hat{p}))}{q(0)} \). Thus, the following condition is needed for a firm to offer the incentive-compatible wage: \( \pi^e \leq \frac{k(r + \Phi(\hat{p}))}{q(0)} \). In this paper, I assume that the condition is satisfied at the equilibrium. Otherwise, not only the incumbent firm, but also the others are unwilling to satisfy constraint (4). The numerical illustration demonstrated in Section 3 satisfies the condition.
indicates that the slope of the IC curve is locally greater than that of the JC curve at an equilibrium.

The JC curve is downward, but the IC curve is complicated. Thus, there can be two types of curve intersection, $E_A$ and $E_B$, as shown in Figure 1a and 1b. The point $E_A$ in Figure 1a is an equilibrium, where the condition in lemma 1 holds. On the other hand, $E_B$ in Figure 1b is not an equilibrium, where the condition in lemma 1 does not hold. The proof of lemma 1 is given in the Appendix.

Point $E_B$ is not an equilibrium because new entry occurs at this point. Suppose some new vacant firms enter the market at point $E_B$. In this case, the market tightness increases from $\theta_3$ to $\theta_4$, as shown in Figure 1b. Under the new market tightness $\theta_4$, a new minimum incentive-compatible wage offered is given as $w_4$, which is lower than the original wage $w_3$. The point $(\theta_4, w_4)$ is below the JC curve; thus, vacant firms' expected profits are positive and greater than at point $E_B$. New vacant firms expect a positive profit, and are thus willing to enter the market. Point $E_B$ is not an equilibrium.

Similarly, we can see that new entry never occurs at point $E_A$. If new vacancies enter the market, market tightness increases from $\theta_1$ to $\theta_2$, as shown in Figure 1a. Under the new market tightness $\theta_2$, a new minimum incentive-compatible wage is given as $w_2$. The point $(\theta_2, w_2)$ is above the JC curve; thus, vacant firms' profits are negative. New entry never occurs. Point $E_A$ is an equilibrium.

8. Effects of EP

First, I consider how the change in the relative share of SP affects the economy given a constant level of firing cost, that is, $f = \bar{f}$.

**Proposition 1**

Suppose the share of SP increases given a constant level $\bar{f}$ of the firing cost. An increase in the share of SP raises the wage and reduces the market tightness. It increases the threshold of dismissal and the unemployment rate.

The proof is given in the Appendix. When the strictness of EP is fixed, that is, $f = \bar{f}$, a firm incurs the same firing cost $f = \bar{f}$ regardless of the share of SP. Because a shirking worker is entitled to receive SP whenever he/she is fired, an increase in the share of SP discourages a worker from making the required effort. To maintain the worker's incentive, the cost for shirking should be higher. A high wage offer with a

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6 The IC curve may have a downward or upward slope. The slope of the IC curve is irrelevant to the result only if lemma 1 holds.
higher threshold of dismissal is therefore necessary to maintain the worker's incentive, which reduces the firm's profit from the match. This is the disincentive effect, which causes vacant firms to exit the market, thereby reducing market tightness. As a result, the unemployment rate increases.

In contrast, if the share of PI increases, the wage decreases and market tightness increases. In addition, the threshold of dismissal and the unemployment rate decline.

3. Numerical Illustration

Proposition 1 holds only when the total firing cost is fixed. This situation, however, is restrictive. The total effect of the firing cost is ambiguous from the theoretical perspective. Hence, I conduct a computer simulation on the search equilibrium, where productivity of a diligent worker is normally distributed with a mean value of 100 and a standard of deviation 35. Similarly, the productivity of a shirking worker is normally distributed with a mean value of 45 and a standard deviation of 35. The worker productivity distributions satisfy the first-order stochastic dominance. The matching function is given as $m(u, v) = 0.7u^{0.7}v^{0.3}$. Other parameters are set as follows: $\bar{w} = 50$, $r = 0.0125$, $c = 25$, and $k = 10$.

1. Market tightness, wage and threshold of dismissal

Since I consider a discrete-time model, both the probability $\theta q(\theta)$ with which an unemployed worker gets a new job, and the probability $q(\theta)$ with which a vacancy is matched to an unemployed worker, must not be greater than 1. From the matching function, $m(u, v) = 0.7u^{0.7}v^{0.3}$, the probability condition, $\theta q(\theta) \leq 1$ and $q(\theta) \leq 1$, leads approximately to $0.60 \leq \theta \leq 3.28$.

The market tightness derived by the numerical illustration is given in Figure 2, where the bold parts of the curves satisfy the above probability condition. Similarly, certain variables in the numerical illustration such as wage, threshold of dismissal, and unemployment rate are represented by the bold parts when they satisfy the above probability condition.

Remark 1

In this simulation, the following results are derived:

[1] As Figure 2 shows, an increase in SP or PI decreases market tightness.
As Figures 3 and 4 show, the incentive-compatible wage and the threshold of dismissal are likely to increase with respect to $s$ (SP), given a level of $z$ (PI).

An increase in PI lowers the incentive-compatible wage and the threshold of dismissal, given a level of $s$ (SP).

Both SP and PI decrease market tightness. An increase in firing cost, regardless of SP and PI, deters vacant firms from entering the market. The effect of SP on market tightness is similar to that of PI. This result is different from the effects brought about by the relative change in the share of SP and PI shown in proposition 1, where an increase in the share of SP decreases market tightness but an increase in the share of PI increases market tightness.

Remark 1[1] indicates that a hike of firing cost discourages firms from employing workers regardless of SP and PI. However, the effects of SP on the other variables are different from the effects of PI, as represented in [2] and [3] of Remark 1.

The equilibrium wage and the threshold of dismissal increase with SP, but decrease with PI. This implies that increasing SP generally inflicts non-negligible damage on worker incentives. As Remark 1[1] indicates, increasing SP decreases market tightness. This effect of SP on market tightness encourages workers to make an effort in the hopes of remaining in their firms, because they are unlikely to get another job if they are fired. However, SP provides earnings for fired workers even if they are shirkers. Thus, workers would probably not hesitate to lose their job because of SP; SP has a negative effect on worker incentives, and a higher wage is needed to maintain the incentive.7 Since increasing SP decreases market tightness, firms can easily employ new workers in the market. Additionally, firms have to pay high wage to maintain worker incentive. Thus, firms would not hesitate to fire workers; the threshold for dismissal increases with SP.

On the other hand, increasing PI positively affects worker incentives as a whole. PI induces firms to exit the market, as does SP, and decreases market tightness, as shown in Figure 2. This effect encourages workers to make an effort, because they are unlikely to get a new job if they are fired. Furthermore, PI does not provide earnings for fired workers. The threat of losing their jobs is still a crucial factor for workers with an increase of PI. Thus, high wage offer is not needed to maintain worker incentive.

7 As shown by the dashed parts of the curves in Figures 3 and 4, increasing SP decreases the equilibrium wage and the threshold of dismissal when SP is very high. A huge SP leads to very low market tightness, and unemployed workers can barely get another job. This is a big incentive for workers, so a high wage and a high threshold for dismissal are not needed. However, the probability condition does not hold in this case.
Contrary to the increase we see with SP, the incentive-compatible wage decreases with PI; this is the difference between PI and SP. PI is less likely than SP to inflict damage on worker incentives.

As shown in Figure 4, the effect of PI on the dismissal threshold is opposite to the effect of SP. Increasing PI is likely to reduce the incentive-compatible wage, and, combined with the hike of PI, has an effect of decreasing the threshold of dismissal. However, increasing PI decreases market tightness, which has an opposite effect of increasing the threshold. The latter effect is dominated by the former one; the threshold of dismissal decreases with PI. Workers are likely to be fired with SP, but not with PI.

2. Unemployment rate

**Remark 2**

As shown in Figure 5, the unemployment rate tends to increase with SP, but it decreases with PI.

As mentioned in Remark 1, increasing SP decreases market tightness, increases the threshold of dismissal and increases the unemployment rate. The effect of increasing PI is more complicated. Increasing PI also decreases market tightness, but the effect on the dismissal threshold is opposite to the effect from an increase in SP: increasing PI decreases the threshold of dismissal. PI’s effect on the dismissal threshold dominates its effect on market tightness, thus, the unemployment rate is likely to decrease with PI.\(^8\)

In this model, the equilibrium inflows to unemployment, which is equivalent to the outflows from unemployment at the equilibrium, is given by the likelihood of dismissal \(\Phi(\hat{p})\). As shown in Figure 4, increasing PI reduces the inflows to unemployment. This indicates that PI has a negative effect on the reallocation of the labor force, which is similar to the results in the literature on employment protection. Consistent with the literature, the simulation shows that the speed of the inflows to and outflows from unemployment is not significantly associated with the unemployment rate.

3. Social welfare

As the same situation is repeated in every period at the equilibrium, it is sufficient to consider social welfare within a period. Social welfare within a period is given by

\(^8\) When SP is small, \(s \leq 8\), the unemployment rate increases with PI, as shown in Figure 5. However, the effect is very small and the probability condition does not hold in this case.
\[ \Omega = \left\{ \int_{\rho} p\phi(p)dp + \Phi(\hat{\rho})(\hat{w} - z) - c \right\}(1-u) + u\hat{w} - k\theta u . \]

The first term means welfare generated by all matches. At the equilibrium, the fraction of workers, \((1-u)\), is employed and bears the effort cost and then produces output in the productivity range of \( p \geq \hat{\rho} \), otherwise they are fired and receive the reservation wage \( \hat{w} \). Workers are fired with the probability of \( \Phi(\hat{\rho}) \), thus PI is deducted as a transaction cost in terms of social welfare. The second and third terms indicate contributions to welfare by unmatched players, the unemployed and vacancies. When vacancies and unemployed workers stay in the market, the unemployed workers receive the reservation wage but vacancies incur the vacancy cost.

**Remark 3**

As shown in Figure 6, social welfare is likely to be negatively associated with SP, but positively associated with PI.

As shown in Figure 6, social welfare first worsens gradually with respect to a low SP, then improves. In the range in which the probability condition holds, SP is likely to decrease social welfare. In contrast, PI tends to improve social welfare. As figure 5 and 6 indicate, social welfare tends to be negatively related to the unemployment rate.

Here, we should consider the search externality. Since social welfare is associated with a search externality, this positive effect on social welfare may be due to the elimination of the negative search externality. I can infer the effect of the search externality. When bargaining power of a worker is weak compared to the elasticity of the matching function, as the Hosios (1990) condition shows, the unemployment rate is excessively low from the perspective of efficiency. In this case, social welfare improves if a policy or an institutional device increases the unemployment rate. In my model, the level of SP is relevant to the bargaining power of a worker because high SP increases the ex post rent \( E-U \) of a worker. High SP is similar to the case in which a worker has strong bargaining power in the textbook model. Actually, as the simulation shows, unemployment rate increases with SP.

In the textbook model of Pissarides (2000), the efficient level of bargaining power is uniquely determined by the Hosios condition. Starting with weak bargaining power of a worker, as the bargaining power increases, social welfare improves initially
and then declines. If the search externality is crucial only to social welfare, the social
welfare curve should be mound shaped with respect to SP: social welfare should first
increase, then decrease with respect to SP in the case of $z=0$. In contrast, in my model,
the social welfare curve is different from textbook models. As shown in Figure 6, social
welfare first decreases, then increases with SP. Thus, the improvement in social welfare
produced by PI is not due to the elimination of search externality.

4. Long-term shock

The discount rate in the simulation is 0.0125, which indicates that the model
uses quarterly periods. Even with low productivity, a worker is unlikely to be fired if the
bad financial situation continues only for a quarter, and the economic condition soon
improves. A firm would be inclined to retain an employee if the low productivity is
expected for only a short period. In contrast, if the low productivity persists for a long
time, a firm would be unwilling to retain the match, and the match would likely
dissolve.

To examine the long-term low productivity situation, I implement a numerical
illustration with a higher discount rate, $r = 0.1$, which indicates that the low productivity
situation continues for approximately 2-4 years. A high discount rate naturally increases
the threshold of dismissal as well as the unemployment rate. However, PI reduces the
unemployment rate in the case of $r = 0.1$ to a greater extent than in the case of $r = 0.0125$.
In Figure 7a, the difference in the unemployment rate between $z =10$ and $z = 0$ is
denoted as $\Delta u \equiv u_{z=10} - u_{z=0}$. The curves decrease with SP. The curve of $\Delta u$ under $r = 0.1$ is always located below the curve under $r = 0.0125$. This shows that, to reduce the
unemployment rate, PI is more effective in the case of $r = 0.1$ than in the case of $r = 0.0125$.

Similarly, the difference in social welfare is denoted as $\Delta \Omega \equiv \Omega_{z=10} - \Omega_{z=0}$. To
compare the effect of PI under the long-term shock with the effect under the short-term
shock, the difference is normalized by the welfare level with $z =0$: $\Delta \Omega / \Omega_{z=0}$, as shown
in Figure 7b. The social-welfare-improving effect is larger in the case of $r = 0.1$ than in
the case of $r = 0.0125$. Thus, the positive effect of PI is not necessarily smaller when
low productivity persists for a long time.

4. Conclusion

I examined the efficiency wage model with matching technology to analyze the
effects of EP on worker incentives. EP generates two effects: the *disincentive effect* and the *commitment effect*. If the latter dominates the former, EP improves social welfare. I also examined the differences between SP and PI. Although SP seems better in terms of social welfare than PI, SP provides earnings for shirking employees, and thus, its effect on worker incentives is likely to be negative compared with PI’s effect on worker incentives.

Similar to the results of previous studies regarding EP, my results on the effects of EP were theoretically ambiguous. I therefore conducted a computer simulation and obtained the following results: [1] Both SP and PI decrease market tightness, and thus deter firms from entering the market. [2] SP tends to increase the equilibrium wage, the threshold of dismissal and the unemployment rate, and it negatively affects social welfare. [3] PI is likely to decrease the equilibrium wage, the threshold of dismissal and the unemployment rate, and it has a positive effect on social welfare. PI is associated with SP, thus it is necessary to design EP appropriately. [4] Increasing PI reduces the inflows to and outflows from unemployment. Consistent with the literature, the speed of the inflows to and outflows from unemployment is not significantly associated with the unemployment rate.

In my model, when a firm realizes that the productivity of a worker is too low to keep the employment relationship, the worker's wage is not adjusted flexibly. Empirically, the degree of wage flexibility has been controversial. The different views on macroeconomic policy often stem from the different views on the extent to which the wage is flexibly adjusted.

Bewley (1999) conducted interviews with over 200 business people, including firm managers, lawyers, and consultants; Campbell and Kamlani (1997) conducted investigations on firm managers. Results from these studies suggest that wages are inflexible because a wage cut seriously damages motivation. Furthermore, according to behavioral economics such as Kahneman, Knetsch, and Thaler (1986) and Agell and Bennmarker (2007), some psychological factors deter firm managers from decreasing wages. In addition to these studies, an experimental study by Fehr and Falk (1999) shows that wages are inflexible even if they confront excessive labor supply and involuntary unemployment. The experimental study indicates that adjusting wages downward is not easy, even in the experiment, the implication being that it is much more difficult to decrease wages in the real business world. As Pissarides (2009) also

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9 Recently, the relationship between wage rigidity and the matching model has been widely discussed. Shimer (2005) indicates that the Mortensen–Pissarides matching model cannot really explain the volatility of unemployment and vacancies; Hall (2005) shows that introducing wage rigidity in the model improves its suitability.
indicates, the wage of a new match relevant to the external wage of outsiders is comparatively flexible, but the continuous wage of an existing match is comparatively inflexible. Therefore, my setting in which the wage is flexibly decided in the beginning of a term employment contract but is inflexible during the contracted term is not unrealistic.

Appendix

Proof of Lemma 1

[1] I begin by showing that the slope of the IC curve should be greater than the curve of the JC curve at an equilibrium, as shown at point $E_A$ in Figure 1a.

In the beginning of a period, there are 4 types of players at equilibrium in this model. The first is the group of firms being matched with workers, the second is the group of firms with vacancies not matched with workers, the third is the group of employed workers, and the fourth is the group of unemployed workers. Here, I consider what the best responses of the players are at an equilibrium.

A firm and a worker matched to each other have an incentive for maintaining the match before the worker's productivity is revealed, because the firm and the worker expect to receive a greater payoff together than when they dissolve their match.

Next, we must consider the behaviors of unmatched players, vacant firms and the unemployed. The unemployed play a trivial role at equilibrium because the only option for the unemployed is waiting for a new job in the market. Since the number of workers is a constant, the unemployed cannot exit the market.

In contrast, vacant firms have the option of entering or leaving the market. Their responses are crucial for the equilibrium. As I indicated, the free entry and exit condition is assumed in this model, thus, the number of vacant firms is determined where the expected payoff of vacant firms is zero at the equilibrium.

First, I consider point $E_B$ in Figure 1b. At this point, matched firms have no incentive for dissolving their matches and leaving the market. Similarly, vacant firms, which have already entered the market, are willing to remain in the market incurring

While Mortensen and Nagypal (2007) and Pissarides (2009) mention that wage rigidity improves the model’s power of explanation, they argue that the model does not require wage rigidity. According to them, the power of explanation improves if other factors such as hiring or firing costs, demand shocks, and on-the-job search behavior are considered in the typical model. In addition, as Kennan (2010), Moen and Roser (2007), and Brugemann and Moscarini (2007) analyzed the issue, asymmetric information, such as adverse selection and moral hazard, magnifies the volatility in unemployment and vacancies.
vacancy cost $k$, because their profit is zero at this point. However, further new entry occurs, because the new entrants anticipate a positive expected profit by their entry for the following reason: New entry increases the market tightness from $\theta_3$ to $\theta_4$. Under the new market tightness $\theta_4$, a new minimum incentive-compatible wage offered is given as $w_4$.

Note that the present value of expected profit of a vacancy is positive below the JC curve. The point $(\theta_4, w_4)$ is below the JC curve; thus, vacant firms' expected profits are positive and greater than expected profits at point $E_B$. New vacant firms can make a positive profit, and they are willing to enter the market at point $E_B$. Point $E_B$ is not an equilibrium.

Next, I consider point $E_A$ in Figure 1a. Similar to point $E_B$, matched and vacant firms are unwilling to leave the market. However, new entry does not occur at point $E_A$. Suppose that some new vacancies enter the market. This increases the market tightness from $\theta_1$ to $\theta_2$. Under the new market tightness $\theta_2$, a new minimum incentive-compatible wage is given as $w_2$. The point $(\theta_2, w_2)$ is above the JC curve; thus, vacant firms' expected profits are negative, less than the zero profit produced when they do not enter the market. Thus, new entry never occurs at point $E_A$. Point $E_A$ is an equilibrium.

[2] Next, I derive the mathematical condition. First, I begin to show $\frac{\partial IC}{\partial w} > 0$ at an equilibrium. Note that constraint (4) is binding at an equilibrium. Now, suppose that $IC_w \leq 0$ at an equilibrium. In this situation, a firm can reduce the wage further while constraint (4) is satisfied, thus increasing the firm’s profit. This contradicts the idea that the original wage maximizes the firm’s profit. Hence, at the equilibrium $IC_w > 0$ holds.

It holds at the equilibrium that $IC(w, \theta) = c$ and $JC(w, \theta) = 0$. Differentiating the functions, IC and JC, with respect to $w$ and $\theta$, the slope of the IC and JC curves are derived: $\frac{dw}{d\theta} = -\frac{IC_0}{IC_w}$ and $\frac{dw}{d\theta} = -\frac{JC_0}{JC_w}$, where $IC_x = \frac{\partial IC}{\partial x}$ and $JC_x = \frac{\partial JC}{\partial x}$ for $x = w$ or $\theta$. Since the slope of the IC curve is greater than the slope of the JC curve at the equilibrium, it holds that $-\frac{IC_0}{IC_w} > -\frac{JC_0}{JC_w}$. Using $JC_w \equiv \tilde{J}_w = -\frac{1 - \Phi(\tilde{r})}{r + \Phi(\tilde{r})} < 0$, $JC_0 = \frac{kq'}{q}$, and $IC_w > 0$, the above inequality is replaced as $IC_w \frac{kq'}{q} - IC_0 \tilde{J}_w < 0$. \]
Proof of Proposition 1

I conduct comparative statics regarding a search equilibrium with respect to $s$ subject to $df = ds + dz = 0$:

$$
\begin{pmatrix}
dw / ds \\
d\theta / ds
\end{pmatrix} = -\begin{pmatrix}
IC_w & IC_0 \\
JC_w & JC_0
\end{pmatrix}^{-1} \begin{pmatrix}
IC_s \\
\tilde{J}_s
\end{pmatrix}.
$$

As shown in the proof of lemma 1, this is rewritten as follows:

$$
\begin{pmatrix}
dw / ds \\
d\theta / ds
\end{pmatrix} = \frac{-1}{IC_w \frac{q'}{q^2} - IC_0 \tilde{J}_w} \begin{pmatrix}
\frac{kq'}{q^2} - IC_0 \\
-\tilde{J}_w IC_w
\end{pmatrix} \begin{pmatrix}
IC_s \\
\tilde{J}_s
\end{pmatrix},
$$

where

$$
IC_s = \frac{\partial IC}{\partial s}, \quad \tilde{J}_w = \frac{\partial \tilde{J}}{\partial w} = 0 \quad \text{under} \quad df = ds + dz = 0. \quad \text{Note that}
$$

$$
\tilde{J}_s = \frac{\partial \tilde{J}}{\partial s} = \frac{\partial \tilde{J}}{\partial f} \frac{df}{ds} = 0
$$

Thus, (A1) turns to

$$
\begin{pmatrix}
dw / ds \\
d\theta / ds
\end{pmatrix} = \frac{-1}{IC_w \frac{q'}{q^2} - IC_0 \tilde{J}_w} \begin{pmatrix}
\frac{kq'}{q^2} IC_s \\
-\tilde{J}_w IC_s
\end{pmatrix}.
$$

Using the condition in lemma 1 and $\tilde{J}_w = -\frac{1}{r + \Phi(\hat{p})} < 0$, it is derived that $\frac{dw}{ds} \bigg|_{f=\tilde{f}} > 0$

and $\frac{d\theta}{ds} \bigg|_{f=\tilde{f}} < 0$. The results lead to $\frac{d\hat{p}}{ds} \bigg|_{f=\tilde{f}} > 0$ from (6), and thus, it holds from (7) that $\frac{du}{ds} \bigg|_{f=\tilde{f}} > 0$.■
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Figure 1a

$E_A$ is an equilibrium.

Figure 1b

$E_B$ is not an equilibrium.
Market tightness: The bold parts of the curves indicate that the probabilities of a firm and a worker to be matched is not greater than 1. Both SP and PI decrease market tightness.
Figure 3

Wage: SP tends to increase the incentive-compatible wage, but PI decreases it. PI may increase the wage when SP is very low, but the range of SP does not satisfy the probability condition.
Figure 4
Threshold of dismissal: SP tends to increase the threshold of dismissal, but PI decreases it.
Figure 5
Unemployment rate: SP tends to increase the unemployment rate, but PI decreases it.
Welfare: Social welfare is negatively associated with SP, but positively associated with PI.
Effect of long-term shock on the unemployment rate: The curves indicate the gap in the unemployment rate between $z=10$ and $z=0$: $\Delta u = u_{z=10} - u_{z=0}$. PI decreases the unemployment rate more under the long-term shock than under the short-term shock.

Effect of long-term shock on social welfare: The curves show the gap in social welfare between $z=10$ and $z=0$: $\Delta \Omega = \Omega_{z=10} - \Omega_{z=0}$. PI improves social welfare more under the long-term shock than under the short-term shock.