# Incentive Contracts and Market Friction*

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**Abstract**

This paper investigates the design of incentive contracts in the frictional matching market where both principals and agents search for each other to trade and agents' actions are subject to the moral hazard problem after matching trading partners. Then we endogenize the determination of the reservation value of agents and show that different types of incentive contracts emerge as the search market equilibrium outcomes. In particular we show that multiple incentive contracts emerge as different steady state equilibria for the same parameter range. We also conduct the comparative statics exercise with respect to the market friction rate and find that equilibrium contract becomes low-powered as the market friction tends to be large. We empirically test and confirm such inverse relationship between the high-poweredness of incentive contracts and the market friction rate by using the micro data surveyed about the recent Japanese labor market.

**Keywords**: Incentive Contracts, Moral Hazard, Search
**JEL Classification Number**: D82, D83, J41

## 1. Introduction

It is observed that different types of incentive contracts are used in real business practices such as labor contracting and inter-firm transactions. As pointed out by Wiiliamson (1975) and others, optimal contracts become "high-powered" and "low-powered" depending on under what governance structures of transactions contracting parties interact with each other. A high-powered incentive contract means that payments to an agent is highly linked with his own performances and hence he is induced to choose high effort while a low-powered incentive contract means such relation is weak and hence agent's incentive is low.[1)]

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However, there are still further rooms to be filled in the existing literature of organizational economics : First it has mostly focused on the issues of how trading mechanisms (contracts) should be designed among contracting parties, taking as given the trading environment such as outside markets. In fact such outside markets have been treated only for introducing the reservation values of contracting parties which are exogenously fixed in the models. However what contracts should be designed may have repercussion effects through the interactions among contracting parties in the markets (e. g., through the process of finding trading partners in the markets[2]). Second the different features of incentive contracts have been explained by attributing them to the different parameter values of the same model. This approach thus cannot account for why different contracts are observed even in similar industries and countries.

In this paper we will take a step further to address the above unsolved issues, by developing the dynamic search model to derive the emergence of multiple incentive contracts in a matching market : Both principals (e. g. firms) and agents (e. g. workers) search for each other to trade and agents' actions are subject to the moral hazard problem after matching trading partners. In contrast to the standard contract theory, we will endogenize the reservation value of an unmatched agent, which is the present value of future expected payoffs obtained when he rejects the current contract offer and returns back to the market for searching a next period match. The novel feature of the model is to combine optimal contracting under limited liability with the endogenization of the reservation value in the search market equilibrium. The high-powered incentive contract which induces the matched agent to choose a high effort becomes optimal contract when a high reservation value of the agent is expected, while offering the low-powered incentive contract which induces the agent to choose a low effort becomes profitable when a low reservation value is expected. Such dynamic interdependency between the design of optimal contract and the reservation value will simultaneously determine them in steady state equilibrium.[3]

Our main finding is that, given any value of the matching probability, when the discount factor is sufficiently close to one there exist multiple steady state equilibria which are characterized as follows : One equilibrium is that the high-powered incentive contract is offered to the matched agents and the high reservation value of an unmatched agent is realized. The other equilibrium is that the low-powered incentive contract is offered and the low reservation value is realized. In other words, different incentive contracts emerges as equilibrium outcomes for the same parameter values of the model. This is in sharp contrast to the existing approach and we can explain why different contracts are used even in similar industries and countries.

Given a high value of discount factor, the equilibrium contracts are also affected by the market friction rate which is measured by the inverse of the probability of an agent to find a new principal. Then we will conduct the comparative statics exercise about the forms of equilibrium contract with respect to the market friction rate. The equilibrium contract is uniquely determined by the low-powered incentive scheme when the market friction tends to be large. This is because when the matching probability of each agent is small his reservation value becomes low, which in turn makes the low-powered incentive contract optimal to be offered by each principal. Thus the high-powered incentive contract emerges only when the market friction is small and it disappears as the market friction tends to be large. This result then leads to the following comparative statics result: Suppose that the market friction is small and hence the economy is in a steady state equilibrium where the high-powered incentive contract is used. Then, if the market friction rate is increased, the economy moves toward the equilibrium where the low-powered incentive contract is offered. This comparative statics result provides the hypothesis that there may exist the inverse relationship between the high-poweredness of equilibrium contracts and the market friction rate.

We will test this hypothesis by using the micro data surveyed by the Japan Institute for Labor Policy and Training in 2003. One of the important trends in a recent Japanese labor market is that firms tend to introduce the performance-based pay for the employees who have not been offered such scheme before. Our theoretical result implies that such tendency of introducing the high-powered incentive scheme may be negatively related to the extent of the labor market friction which is measured by the duration of finding the current jobs after quitting the previous jobs. In fact, by testing this hypothesis, we confirm that such inverse relationship is actually observed in the recent Japanese labor market.

The rest of the paper is organized as follows: In section 2 we will set up the simple search model and in section 3 we will derive the optimal contracts given the reservation values. In section 4 we will derive the steady state equilibrium of the matching market. In section 5 we will empirically test the hypothesis that the incentive contracts becomes more high-powered as the market friction tends to be smaller.

## 2. The Model

We will consider a matching market where there are initially a continuum of principals with measure $m$ and a continuum of agents with measure $n$.[4] Time runs discrete and extends over infinity. Each principal needs to hire at most one agent for production. Let $M(n_t, m_t)$ denote the total matches between the principals and the agents who are active in the market at period $t$ when the total numbers of the principals and the agents are given by $m_t$ and $n_t$ respectively. Let $\alpha \equiv M(n, m)/n \in (0, 1)$ and $\beta \equiv M(n, m)/m \in (0, 1)$ respectively. We also assume that there are exogenous inflows of new $\beta m$ principals and $\alpha n$ agents into the matching market at every period. All the principals and agents who matched and took place production leave the market. Thus, these assumptions ensure that the population sizes of the principals and the agents are kept constant at their initial levels $m$ and $n$ over time whenever all matches in every period result in immediate productions.[5]

Each principal is risk neutral and has a project to be completed by hiring an agent. The project returns are verifiable and depend on both the action taken by a matched agent, $a \in \{0, 1\}$, and some stochastic shock which is independent of all other principals' projects. We assume that the project return $y$ takes either a high value $y_h > 0$ or a low value $y_l$ with probabilities $P_a$ and $1-P_a$ respectively where $P_a \in (0, 1)$ for all $a$ and $P_1 > P_0$. Let $\Delta P \equiv P_1 - P_0 > 0$ and $y \equiv y_h - y_l > 0$.

Each agent is risk neutral and and chooses an action $a \in \{0, 1\}$, which is observable only to himself, by incurring the personal cost $ga$ where $g > 0$. Agent's per period utility function is additively separable over his income and action cost.

All the principals and agents are protected by limited liability : wages of any agent must be non-negative and ex post payoffs of any principal (realized returns minus wage payments) must be non-negative for any project realization. The latter restriction on the side of the principals are made only for the technical reason that the set of possible wage offers by each principal is bounded and hence we can apply the one-stage deviation principle to check the incentive for each principal not to deviate from the equilibrium contract offer (See Fudenberg and Tirole (Chapter 4, 1991))[6]. To avoid the complicated argument, we will assume that the low return $y_l$ is large enough so that the limited liability constraint of the principal is never binding in equilibrium.[7] Thus in what follows we will subtract the limited liability constraint on the side of the principals from the main argument.

Finally the principals and agents all have the common discount factor $\delta \in (0, 1)$. Each principal (agent) will obtain the outside payoff, normalized to be zero, in the period when she (he) does not match a trading partner. The principal also has full the bargaining power to make a take-it-or-leave-it contract offer to the matched agent.

In the following we will consider only steady state equilibrium where all matched principals offer the same contract in every period and the reservation values of the principals and agents become constant over time.

## 3 . Optimal Contracts

Let $U \geq 0$ denote the reservation value of an unmatched agent, who does not match any principal at all or matches a principal but rejects her contract offer, in a steady state equilibrium. Then we will solve the optimal contracting problem between the matched principal and agent, given this value $U$.

First we consider the first best case that agents' actions are verifiable. In this case any matched principal simply offers the wage equal to $U+ga$ to the matched agent for inducing an action $a$. Then the principal obtains the expected payoff as $P_a y_h + (1-P_a) y_l - ga - U$. We will assume the following :

**Assumption 1.** $\Delta P_1 > g$.

Assumption 1 says that in the first best case it becomes optimal for each principal to induce the agent to choose high action $a=1$.

Now we will turn to the second best case that agents' actions are unobservable to the principals. Then we will make the following assumption :

**Assumption 2.** (i) $P_1(g/\Delta P) > \Delta P_y$ and (ii) $P_1 y + y_l > P_1(g/\Delta P)$.

Assumption 2 (i) will ensure that in the second best case each matched principal induces the matched agent to choose low action $a=0$ instead of inducing high action $a=1$ if the reservation value $U$ is given by zero. Assumption 2 (ii) states that the expected payoff of the principal is positive in the second best optimum when the matched agent is induced to choose high action $a=1$ and obtains the positive rent $P_1(g/\Delta P)-g$.

Let $(w_h, w_l)$ denote an incentive contract which specifies two wages, $w_h$ and $w_l$ as follows: $w_h \geq 0$ to be paid when the realized return is high $y=y_h$ and $w_l \geq 0$ to be paid when it is low $y=y_l$ respectively. If the principal wants to induce low action $a=0$ from the matched agent, she will simply pay a fixed wage $w_h=w_l=U$. In this case the matched principal will obtain the expected payoff:

$$\pi_0(U) \equiv P_0 y_h + (1-P_0) y_l - U, \tag{1}$$

provided she actually offers such contract.

On the other hand, if the principal wants to induce high action $a=1$, she must solve the following problem:

$$\min P_1 w_h + (1-P_1) w_l$$

subject to

$$P_1 w_h + (1-P_1) w_l - g \geq P_0 w_h + (1-P_0) w_l \tag{IC}$$
$$P_1 w_h + (1-P_1) w_l - g \geq U \tag{IR}$$
$$w_h \geq 0, \quad w_l \geq 0 \tag{LL}$$

Here (IC) is the incentive compatibility constraint to ensure that choosing high action $a=1$ is optimal for the matched agent instead of choosing low action $a=0$. (IR) is the individual rationality constraint that the matched agent accepts the incentive contract $(w_h, w_l)$ instead of rejecting it and re-entering the matching market to search a new principal, which gives him the reservation value $U$. Finally (LL) means the limited liability constraint on the side of the agents.[8)]

The optimal contract $(w_h, w_l)$ to solve the above problem is simply given by the following lemma.

**Lemma.** *The optimal contract to solve the above problem is characterized as follows:* (i) $w_l=0$ *and* $w_h=g/\Delta P$ *if* $P_1 g/\Delta P - g \geq U$, *and* (ii) *any* $(w_h, w_l)$ *such that* $P_1 w_h + (1-P_1) w_l = g+U$ *and* $\Delta P(w_h - w_l) \geq g$ *otherwise respectively.*

By this lemma, the expected payoff of a matched principal who induces the matched agent to choose high action $a=1$ is given by

$$\pi_1(U) \equiv P_1 y_h + (1-P_1) y_l - \max\{P_1(g/\Delta P), \; U+g\}. \tag{2}$$

Note that when (IR) is not binding $\pi_1(U)$ takes a constant value $P_1 y + y_l - P_1(g/\Delta P)$, which can be positive by Assumption 2 (ii).

Finally, let $\Pi \geq 0$ denote the reservation value of an unmatched principal in a steady state equilibrium. Then, if a principal offers no contracts even when she matches an agent, she will obtain $\Pi$. We will see below that any matched principal will offer the optimal contract in any steady state equilibrium, because $\max\{\pi_0(U),\ \pi_1(U)\} \geq \Pi$ will be satisfied. Thus, the population sizes of the principals and agents will be kept constant at their initial levels $m$ and $n$ over time in any steady state equilibrium. This means that the matching probabilities of a principal and an agent are given by $\beta \in (0,\ 1)$ and $\alpha \in (0,\ 1)$ in every period respectively.

## 4. Search Equilibrium

We will now characterize the steady state equilibrium in the matching market.

The reservation value of an unmatched agent $U$ is given by

$$U=\delta\{\alpha V+(1-\alpha)U\} \tag{3}$$

where $V$ is the expected payoff of an agent when he matches a principal.

First consider the first best benchmark where agent's action is verifiable. Then any matched principal will set the wage $w=U+g$ and hence any matched agent will obtain $V=U$. Thus we have $U=0$ in any steady state equilibrium. Since inducing high action $a=1$ becomes optimal due to Assumption 1 and the expected payoff $P_1 y+y_l-g$ is positive due to Assumption 2 (i), any matched principal offers the first best contract with $w=g$, given $U=0$. Note that in the first best situation the multiplicity of incentive contracts never arises.

Next we will consider the second best case. The optimal contract characterized in Lemma determines the expected payoff $V$ of a matched agent as follows:

$$V\equiv\begin{cases} U & \text{if } \pi_0(U)>\pi_1(U), \\ \max\{P_1(g/\Delta P)-g,\ U\} & \text{if } \pi_1(U)\geq\pi_0(U), \end{cases} \tag{4}$$

provided the match between a principal and him results in the optimal contract offer by the principal. In equation (4) the matched agent will obtain the expected payoff $\max\{P_1(g/\Delta P)-g,\ U\}$ when the principal will implement high action $a=1$ (i. e., $\pi_1(U)\geq\pi_0(U)$) while he will obtain the fixed wage equal to the reservation value $U$ again when she will implement low action $a=0$ (i. e., $\pi_1(U)<\pi_0(U)$).

The reservation value of an unmatched principal is given by

$$\Pi=\delta\{\beta\max\{\pi_0(U),\ \pi_1(U)\}+(1-\beta)\Pi\}, \tag{5}$$

provided the next period match between her and an agent results in the optimal contract offer by herself. Solving this yields

$$\Pi=\frac{\delta\beta\max\{\pi_0(U),\ \pi_1(U)\}}{1-\delta(1-\beta)}$$

which shows that $\max\{\pi_0(U),\ \pi_1(U)\} \geq \Pi$ if and only if $\max\{\pi_0(U),\ \pi_1(U)\} \geq 0$. Thus, when this inequality holds, offering the optimal contract becomes more profitable than offering nothing and staying in the market for searching a next match, which gives such deviating principal the value $\Pi$.

By assuming $V = P_1(g/\Delta P) - g$ and solving equation (3) for $U$, we obtain

$$U = U_h(\delta) \equiv \frac{\delta\alpha[P_1(g/\Delta P) - g]}{(1-\delta(1-\alpha))} > 0.$$

This gives the reservation value of an agent who unmatched a principal in the current period and will be offered the high-powered incentive contract $(w_h,\ w_l) = (g/\Delta P,\ 0)$ when he will match a principal in the future.

Now we will show the following result.

**Proposition 1.** *Suppose that Assumption 1 and 2 hold. Then, if $\delta$ is sufficiently close to one, there exist multiple steady state equilibria as follows:* (i) *the high-powered incentive contract $(w_h,\ w_l) = (g/\Delta P,\ 0)$ is offered and the reservation value of an unmacthed agent is given by $U = U_h(\delta)$, and* (ii) *the low-powered incentive contract $(w_h,\ w_l) = (0,\ 0)$ is offered and $U = 0$.*

**Proof.** Suppose first that $U = U_h(\delta)$. Then, given $U_h(\delta)$, any matched principal will offer the high-powered incentive contract $(w_h,\ w_l) = (g/\Delta P,\ 0)$ to the matched agent when $U_h \in [U^*,\ U^{**}]$ where $U^*$ satisfies $P_0 y - U^* = P_1 y - P_1(g/\Delta P)$ and $U^{**} \equiv P_1(g/\Delta P) - g$. This is because $\pi_1(U) \geq (<) \pi_0(U)$ for $U \geq (<) U^*$. Here $U^* < U^{**}$ holds due to Assumption 1. Note also that $U_h(\delta) < U^{**}$ for all $\delta \in (0,\ 1)$. Furthermore, when $\delta \to 1$, $U_h(\delta) > U^*$ also holds because of Assumption 1. Since $\pi_1(U_h(\delta)) = P_1 y + y_l - P_1(g/\Delta P) > 0$ by Assumption 2 (i), any matched principal has no incentives to make no contract offers and stay in the market for searching a next match. Thus, when $\delta$ is close to one, $(w_h,\ w_l) = (g/\Delta P,\ 0)$ and $U = U_h(\delta) > 0$ constitute a steady state equilibrium.

Second suppose that $U = 0$. Then, given $U = 0$, any matched principal will offer the low-powered incentive contract $(w_h,\ w_l) = (0,\ 0)$ to the matched agent instead of inducing high action $a = 1$, due to Assumption 1. Also, since $\pi_0(0) = P_0 y + y_l > 0$, any matched principal has no incentives to make no contract offers and stay in the market for searching a next match. Thus, $(w_h,\ w_l) = (0,\ 0)$ and $U = 0$ constitute a steady state equilibrium as well. Q. E. D.

The intuition behind Proposition 1 is as follows: Suppose that all players expect that the reservation value of an unmatched agent is given by the outside payoff $U = 0$. Then any matched principal optimally offers the low-powered incentive contract $w_h = w_l = 0$ to the matched agent because by Assumption 2 (i) it is optimal to do so instead of inducing the agent to work hard by incurring the incentive cost $P_1(g/\Delta P)$ which is needed to induce high action from the agent. Thus the reservation value $U = 0$ can be consistent with the low-powered incentive contract. On the other hand, suppose that all players expect that any unmatched agent will obtain a high reservation value $U_h(\delta)$. Then it becomes for each matched principal to offer the high-powered incentive contract characterized by Lemma, given $U_h(\delta)$. Thus, by the recursive equation (3) to determine the reservation value of an unmatched agent $U$, the high-powered incentive contract can be consistent with such value.

We here emphasize that we do not directly introduce any externality and strategic complementarity among the principals and agents in order to derive such multiple steady state equilibria: There are no technological and statistical relations among the productions in matched pairs. The main source for multiple equilibria is the dynamic interdependency between expectation about the future values of unmatched agents and optimal contracting under limited liability. An expectation about high reservation value of an unmatched agent leads to the offer of the high-powered incentive contract, which in turn yields some positive rents to the matched agents and hence such high reservation value will be actually realized as a steady state equilibrium. By the opposite reason, the low reservation value $U=0$ will be realized in the consistent way of the low-powered incentive contract being offered in the market.

Next we will conduct the comparative statics exercise about the forms of equilibrium contract with respect to the market friction rate measured by the inverse of the matching probability of an agent $1/\alpha$, given a high value of discount factor $\delta \in (0, 1)$.[9] Suppose that the market friction rate is so small that the economy is in a steady state equilibrium where the high-powered incentive contract is offered to the matched agents. Then, if the market friction rate $1/\alpha$ is increased, the search market equilibrium will change its feature from the high-powered incentive contract to the low-powered incentive contract. This is because the high-powered incentive contract cannot be a steady state equilibrium when the matching probability $\alpha$ is small enough so that $U_h(\delta) < U^*$ is satisfied: When $U_h(\delta) < U^*$, any matched principal has the incentive to offer the low powered incentive contract $w_h = w_l = U_h(\delta)$ because $\pi_0(U_h(\delta)) > \pi_1(U_h(\delta))$ by definition of $U^*$. Thus $U = U_h(\delta)$ cannot be consistent with the high-powered incentive contract when $U_h(\delta) < U^*$.

**Proposition 2.** *Suppose that the matching probability $\alpha$ is so small that $U_h(\delta) < U^*$ is satisfied. Then a unique steady state equilibrium is characterized by the low-powered incentive contract.*

From this comparative statics result we conclude that the inverse relationship between the high-poweredness of incentive contracts and the market friction rate may be observed.[10] In the next section we will test this hypothesis by using the Japanese labor market micro data surveyed by the Japan Institute for Labor Policy and Training in 2003.

## 5. Empirical Test

### 5.1 Data

In 2003 the Japan Institute for Labor Policy and Training conducted the survey about

DESCRIPTIVE STATISTICS

| | Mean | Standard Deviation |
|---|---|---|
| PER | 0.46586 | 0.49908 |
| SEX | 0.75703 | 0.42909 |
| AGE | 43.03815 | 10.06165 |
| OCU1 | 0.13253 | 0.33924 |
| OCU2 | 0.059237 | 0.23619 |
| OCU3 | 0.25301 | 0.43496 |
| OCU4 | 0.36145 | 0.48066 |
| OCU5 | 0.092369 | 0.28969 |
| MID | 0.81526 | 0.38828 |
| LARGE | 0.16566 | 0.37196 |
| DUR | 10.56627 | 18.11634 |
| IND1 | 0.0050201 | 0.07071 |
| IND2 | 0.1496 | 0.35686 |
| IND3 | 0.19578 | 0.397 |
| IND4 | 0.016064 | 0.12579 |
| IND5 | 0.15361 | 0.36076 |
| IND6 | 0.065261 | 0.24711 |
| IND7 | 0.089357 | 0.2854 |
| IND8 | 0.0070281 | 0.083581 |
| EDU1 | 0.35241 | 0.47796 |
| EDU2 | 0.077309 | 0.26722 |
| EDU3 | 0.11647 | 0.32094 |
| EDU4 | 0.40462 | 0.49106 |
| EDU5 | 0.01506 | 0.12185 |
| EMP | 11.53514 | 9.11638 |
| Sample size | 996 | |

Notes: Variables are difined in Appendix A.

Table 1

recent Japanese labor practices, called *A Survey on the Personnel Strategies of the Firms and Workers' Feeling on their Employment Environments 2003* (Kigyou no Jinji Senryaku to Roudousya no Syuugyou Ishiki Chousa 2003 in Japanese), by selecting 5000 firms from the *Teikoku Data Bank*, called COSMOS2, and sending questionnaires to 10 employees for each firm (Thus total number of the employees to which questionnaires were sent is 50000). Such data is available by the data archive (called SSJ Data Archive) provided by the Institute of Social Science of the University of Tokyo.

The key questions asked to them include the following as well as their personal data such as sexes, ages and educational background:

(i) Do you think that your salary is determined by reflecting your own performances?

(ii) How many months/years did you spend to find your current job after you quit the previous job?

Among total 50000 samples selected, only 7566 employees have sent replies to these questionnaires. The answer to the second question (ii) was selected only one from the following: 1) less than one month, 2) from one month to three months, 3) from three months to six months, 4) six months to nine months, 5) nine months to one year, 6) from one year to three years, 7) three years to five years, and 8) more than five years.

The summary statistics is reported in Table 1. Here all variables reported are dummy variables except ages (AGE), average employment duration of current jobs (EMP) and the duration spent for finding the current jobs after quitting the previous jobs (DUR). The dummy variable PER takes one when an employee answered YES to the above first question (i) and zero otherwise respectively. We will interpret PER as the variable representing the extent of how much wage contracts become high-powered. On the other hand, the dummy variable DUR (the duration of unemployment) represents the degree of the labor market friction. MID and LARGE represent the dummy variables representing the sizes of the sample firms. $\left\{\mathrm{IND}\right\}_{j=1}^{5}$ and $\mathrm{EDU}_{j=1}^{5}$ represent the industry dummy and educational background dummy respectively.

## 5.2 Empirical Results

We will test whether or not the high-powered incentive contract is more likely to be introduced when the labor market friction rate becomes smaller. In order to test this hypothesis, we will use the following regression equation:

$$\begin{aligned}\mathrm{PER}=&\,C+\beta_1\mathrm{SEX}+\beta_2\mathrm{AGE}+\sum_{j=1}^{5}\beta_j\mathrm{OCU}_j+\beta_4\mathrm{MID}\\&+\beta_5\mathrm{LARGE}+\beta_6\mathrm{DUR}+\sum_{j=1}^{8}\gamma_j\mathrm{IND}_j\\&+\sum_{j=1}^{5}\eta_j\mathrm{EDU}_j+\delta\mathrm{EMP}+\xi.\end{aligned}$$

As we have already explained, the dependent variable PER is the dummy variable which takes one if an employee answers YES to the question (i) and zero otherwise. For the variable representing the duration of unemployment, DUR, we used the median of each category 1)-8) we have already mentioned. For example, for category 2) (the unemployment duration is from one month to three months) we used its median, two months. We also classified the total sample into the following three samples according to how many months/years were spent for finding the current jobs after quitting the previous jobs: (A) less than five years, (B) less than three years and (C) less than one year.

The regression result is reported in Table 2. Here (A), (B) and (C) are the regression equations applied to the selected samples we have classified above. We can then show that the coefficient of DUR is negative and significant at 99% and 95% confidence levels in equations (B) and (C) respectively. In other words there is the strong negative effect of the unemployment duration on the introduction of performance-based pay. This is consistent with our theoretical observation that the equilibrium contract offered in a frictional labor market becomes low-powered as the market friction which is inversely related to the matching probability of an unemployed worker tends to be large.

From the regression results we can also observe that the negative effect of the unemployment duration on the high-poweredness of incentive contracts is stronger in equation (A) than others as well as equation (A) has the largest Log-likelihood (−522.683). Since the samples selected in equation (A) are those who spent the shortest period to find the current jobs among the three, this result implies that the above negative effect becomes stronger in a shorter unemployment period than a longer period. In other words, when a slight reduction of the market friction (measured by the unemployment duration) occurs, the employees who spent less time to find the current jobs after quitting the previous jobs are more likely to be offered the high-powered incentive contracts than those who spent more time to do so.[11)]

| | (A) | | (B) | | (C) | |
|---|---|---|---|---|---|---|
| C | -0.972 | ** | -0.967 | ** | -0.918 | ** |
| | (-2.01) | | (-1.97) | | (-1.78) | |
| SEX | 0.131 | | 0.150 | | 0.110 | |
| | (1.11) | | (1.23) | | (0.85) | |
| AGE | 0.012 | ** | 0.012 | *** | 0.012 | ** |
| | (2.27) | | (2.34) | | (2.05) | |
| | [0.00451] | | [0.00474] | | [0.00441] | |
| OCU1 | -0.233 | | -0.233 | | -0.136 | |
| | (-1.20) | | (-1.17) | | (-0.65) | |
| OCU2 | -0.684 | *** | -0.706 | *** | -0.613 | ** |
| | (-2.86) | | (-2.82) | | (-2.29) | |
| OCU3 | -0.109 | | -0.103 | | -0.021 | |
| | (-0.64) | | (-0.59) | | (-0.11) | |
| OCU4 | -0.177 | | -0.159 | | -0.066 | |
| | (-1.05) | | (-0.92) | | (-0.36) | |
| OCU5 | -0.018 | | 0.003 | | 0.099 | |
| | (-0.09) | | (0.01) | | (0.45) | |
| MID | 0.188 | | 0.213 | | 0.211 | |
| | (0.61) | | (0.68) | | (0.68) | |
| LARGE | 0.384 | | 0.415 | | 0.394 | |
| | (1.18) | | (1.26) | | (1.19) | |
| DUR | -0.004 | | -0.011 | ** | -0.043 | *** |
| | (-0.96) | | (-1.81) | | (-2.45) | |
| | [-0.00139] | | [-0.00432] | | [-0.01623] | |
| IND1 | -0.389 | | -0.438 | | -0.435 | |
| | (-0.54) | | (-0.60) | | (-0.61) | |
| IND2 | 0.095 | | 0.067 | | 0.012 | |
| | (0.69) | | (0.48) | | (0.08) | |
| IND3 | 0.223 | ** | 0.230 | ** | 0.257 | ** |
| | (1.72) | | (1.73) | | (1.84) | |
| IND4 | 0.622 | ** | 0.510 | * | 0.660 | ** |
| | (1.87) | | (1.45) | | (1.76) | |
| IND5 | 0.185 | * | 0.125 | | 0.185 | |
| | (1.30) | | (0.86) | | (1.20) | |
| IND6 | 0.506 | *** | 0.520 | *** | 0.479 | *** |
| | (2.74) | | (2.73) | | (2.41) | |
| IND7 | 0.004 | | -0.042 | | -0.059 | |
| | (0.03) | | (-0.25) | | (-0.33) | |
| IND8 | 0.034 | | 0.020 | | 0.005 | |
| | (0.07) | | (0.04) | | (0.01) | |
| EDU1 | 0.110 | | 0.024 | | 0.007 | |
| | (0.44) | | (0.10) | | (0.02) | |
| EDU2 | 0.184 | | 0.190 | | 0.078 | |
| | (0.63) | | (0.64) | | (0.24) | |
| EDU3 | 0.123 | | 0.059 | | 0.003 | |
| | (0.43) | | (0.21) | | (0.01) | |
| EDU4 | 0.157 | | 0.111 | | 0.083 | |
| | (0.61) | | (0.43) | | (0.28) | |
| EDU5 | 0.343 | | 0.474 | | 0.088 | |
| | (0.81) | | (1.06) | | (0.17) | |
| EMP | -0.002 | | -0.000 | | 0.002 | |
| | (-0.30) | | (-0.08) | | (0.40) | |
| | [-0.00061] | | [-0.00017] | | [0.00089] | |
| Log-likelihood | -612.619 | | -582.836 | | -522.683 | |
| Sample size | 917 | | 877 | | 787 | |

Notes:
1) In equation (A) the total sample size of the employees who found the current jobs within 5 years is 917 and those who answered YES to the question (i) are 425 among them.
2) In equation (B) the total sample size of the employees who found the current jobs within 3 years is 877 and those who answered YES to the question (i) are 406 among them.
3) In equation (C) the total sample size of the employees who found the current jobs within 1 years is 787 and those who answered YES to the question (i) are 370 among them.
4)*the coefficient estimate is statistically significant at the 10 per cent level.
**the coefficient estimate is statistically significant at the 5 per cent level.
***the coefficient estimate is statistically significant at the 1 per cent level.
5)Estimated *t*-values are in parentheses.
6)maginal effect for DUR are in [ ].

Table 2

## 6. Conclusion

In this paper we provided the search theoretic framework to explain the diversity of incentive contracts by endogenizing the reservation value of agents in search market equilibrium. We showed that there exist multiple steady state equilibria characterized by the high-powered and low-powered incentive contracts for the same parameter values of the model. We also showed that the equilibrium contracts are affected by the market friction rate: The equilibrium changes from the high-powered incentive contract to the low-powered one as the market friction (measured by the inverse of the matching probability) becomes larger. Finally we empirically tested this hypothesis by using the micro data surveyed by Japan Institute for Labor Policy and Training in 2003.

### Notes

1) See Holmstöm and Milgrom (1991) for one explanation to why contracts used in practice are often low-powered. They show that the optimal contract becomes a fixed wage contract which fully absorbs the risk imposed on agent in the multi-task agency model.

2) Exceptions are the recent studies by Grossman and Helpman (2002) and McLaren (2000). They consider the industry market equilibrium where the choice of outsourcing and vertical integration by final goods manufacturers is endogenously determined.

3) See Ishiguro (2004) for a similar search theoretic framework to address the issues of how diversity of organizational structures emerge.

4) The structure of the matching market we will consider is similar to the bargaining model in the matching markets analyzed by Osborne and Rubeinstein (Chapter 6, 1990).

5) This will be actually the case occurred in steady state equilibrium we will see below.

6) When we check that some strategy profile can be an equilibrium, this principle allows us to check only that the one period deviation by a single player is not unilaterally profitable by assuming that he confirms to the specified strategy in subsequent periods. This principle holds when the per period payoff function of each player is uniformly bounded and the future payoffs are discounted at constant rate. See Fudenberg and Tirole (Chapter 4, 1991). Since the set of possible contract offers by a principal is bounded by her limited liability, her per period payoff is bounded as well. Also, the set of possible actions by an agent is bounded. Thus we can apply this principle.

7) This will be actually the case when $y_l > g/\Delta P$.

8) As we have explained, we are here omitting the limited liability constraints on the side of the principals, i. e., $y_h \geq w_h$ and $y_l \geq w_l$, because the low return $y_l$ is assumed to be large enough and hence these constraints are never binding in equilibrium.

9) Here we maintain a high value of discount factor, because otherwise equilibrium contract is always characterized by the low-powered incentive contract for all values of the matching probability $\alpha \in (0, 1)$ (See Proposition 2 below). This is because even when $\alpha$ is close to one $U_h(\delta) < U^*$ will hold for small $\delta$ so that the high-powered incentive contract never appears.

10) In the different context MacLeod and Malcomson (1998) found the inverse relationship be-

tween the payments based on subjective evaluation and the unemployment rate by using the relational contracting model where a firm and workers implicitly agree with contractual terms like payment and effort over time.

11) In equation (A) where the duration of unemployment is less than five years the coefficient of DUR is negative but not significant. This may be due to the fact that the persons who are unemployed more than three years may be the women who temporally quit the previous jobs for looking after their children and entered the unemployed pool for long periods.

## References

[1] Fudenberg, D. and J. Tirole (1991), *Game Theory*, MIT Press.

[2] Holmstöm, B. and P. Milgrom (1991), "Multitask Principal-Agent Analysis: Incentive Contracts, Asset Ownership and Job Design," *Journal of Law, Economics and Organization* 7, 24-52.

[3] Grossman, G. M. and E. Helpman (2002), "Integration versus Outsourcing in Industry Equilibrium," *Quarterly Journal of Economics*, 117, 85-120.

[4] Ishiguro, S. (2004), "Endogenous Diversity of Organizations," Osaka University.

[5] McLaren, J. (2000), "Globalization and Vertical Structure," *American Economic Review*, 90, 1239-1254.

[6] MacLeod, B. W. and J. M. Malcomson (1998), "Motivation and Markets," *American Economic Review* 88, 388-411.

[7] Osborne, M. J. and A. Rubeinstein (1990), *Bargaining and Markets*, Academic Press.

[8] Williamson, O. E. (1975), *Markets and Hierarchies: Analysis and Antitrust Implications*, New York: The Free Press.

## Appendix A

PER: (=1 if YES to the question(i): Do you think that your salary is determined by reflecting your own performances?)

C: Constant

SEX: (=1 if Male and 0 if Female)

AGE

OCU1: Occupation Dummy (=1 if profession)

OCU2: Occupation Dummy (=1 if engineer)

OCU3: Occupation Dummy (=1 if manager)

OCU4: Occupation Dummy (=1 if clerk)

OCU5: Occuparion Dummy (=1 if sales/services/security)

MID: Middle Firm Size (=1 if the number of employee is more than 100 but lower than 999)

LARGE: Large Firm Size (=1 if the number of employee is more than 1000)

DUR: Duration spent to find the current job after quitting the previous job, classified into the following 8 categories: 1) less than one month, 2) from one month to three months, 3) from three months to six months, 4) from six months to nine months, 5) from nine months to one year, 6) from one year to three years, 7) from three years to five years, 8) more than five years

IND1: Industry Dummy 1 (=1 if mining)

IND2 : Industry Dummy 2 (=1 if construction)

IND3 : Industry Dummy 3 (=1 if manufacturing)

IND4 : Industry Dummy 4 (=1 if electricity, gas, hot water supply or water supply)

IND5 : Industry Dummy 5 (=1 if communication or transportation)

IND6 : Industry Dummy 6 (=1 if wholesale or retail trade)

IND7 : Industry Dummy 7 (=1 if finance or insurance)

IND8 : Industry Dummy 8 (=1 if real estate)

EDU1 : Educational Background Dummy 1 (=1 if the final educated school is high school)

EDU2 : Educational Background Dummy 2 (=1 if the final educated school is other college than those mentioned in EDU3)

EDU3 : Educational Background Dummy 3 (=1 if the final educated school is two-year college or technical college)

EDU4 : Educational Background Dummy 4 (=1 if the final educated school is four-year university)

EDU5 : Educational Background Dummy 5 (=1 if the final educated school is master or doctor course in graduate school)

EMP : average employment years of the current job