OWNERSHIP, INCENTIVES, and MONITORING[*]

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Contents:

Discussion Paper
No.TE/01/413
March 2001

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[*] We are grateful for helpful comments from Patrick Bolton, Oliver Hart, Bentley MacLeod, John Moore, Louis Putterman and Martin Weitzman; and for editorial help from Nancy Hearst.

Abstract

This paper studies the effect of ownership structure on workers' incentives for investing in firm-specific human capital. Particularly, we analyse such incentives and monitoring under employee ownership and capitalist ownership. In our model, the employee-owned firm is a firm bought by its workers who pay the competitive price. Under certain conditions, we show that the workers' investment and expected income are higher and the monitoring intensity is lower in an employee-owned firm than they are in a capitalist firm. We also show that the incentive effect of employee ownership increases as a worker's reservation wage decreases, as the monitoring cost or as the productivity uncertainty increases. Most of our results are consistent with the available empirical evidence.

Keywords: Employee ownership; monitoring; incentives; property rights.
JEL Nos.: D23, J54.

Ownership, Incentives, and Monitoring

1 Introduction

In a conventional capitalist firm (CF), capital hires labor, whereas in an employee-owned firm (EOF), labor hires capital. The question of which ownership form is better has attracted the attention of economists for a long time. Aside from pure theoretical interests,[1]a great deal of empirical observations and policy issues are emerging which are related to the employee-owned firm,[2]to the growing mixed ownership in market economies, such as employee stock-ownership plans (ESOP) and profit sharing schemes,[3]and to the privatization in formerly socialist countries.[4]

There is a large literature addressing problems in employee ownership. View points that are addressed include, among others, the difficulties for EOFs in raising capital (Jensen and Meckling, 1979; Dow, 1993); inefficient collective decision making when employee owners' preferences are heterogeneous (Hansmann, 1996; Hart and Moore, 1998)[5]; the free-rider problem, particularly when the size of the EOF is large (Alchian and Demsetz, 1972; Holmstrom, 1982); and the negative effect on competition when the assets are owned jointly by employees which may affect their *ex ante* human capital investments (Bolton and Xu, 1998)[6]. The objective of the EOF is also considered a source of its problem in the early literature (Ward, 1958; Domar, 1966; Vanek, 1970; Meade, 1972). Despite these shortcomings, it has been argued that employee ownership may encourage workers' effort. The existing arguments for the incentive effect of the EOF are restricted to small firms.[7]However, empirical findings suggest that employee ownership, or elements of employee ownership, such as ESOP or profit sharing, seems to improve productivity by providing better incentives regardless of the size of the firm.[8]

This paper presents a model which shows that employee ownership can provide better incentives for employees, even when the size of the firm is large. We focus on incentives for workers' firm-specific human capital (SHC) investment and we explicitly analyze monitoring issues when workers' human capital investment is unobservable and unverifiable. We compare two pure ownership forms – the CF and the EOF, and do not consider mixed ownership, which is an important future research topic.

The main driver of the model is the observation that, in a CF, the managers have private information about the profitability of the firm that the employees don't have, whereas in an EOF, such information asymmetry is less severe. Regarding capitalist firms, Lewin (1984) suggests that, even in publicly-traded firms, detailed information about profits and production plans is considered proprietary and is not ordinarily available to employees. Ben-Ner and Jun (1996) observe that "unions' demands to open company books have almost universally been met with resistance by employers." (Also see Justice, 1983; Kleiner, 1984.)[9]Even if the company wants to share the information with the employees when the company is not doing well and hence asks employees for wage concessions, it may not be able to do so in a credible way, because the employees cannot effectively interpret the information without sustained experience with the company's books and participation in the company's management (Hall and Lazear, 1984; Kahn and Huberman, 1988; Ben-Ner and Jun, 1996). In an EOF, however, the employee-owners have residual rights of control, including the right to audit the manager's report (Grossman and Hart, 1986), the right to participate in the management of the firm, and the right to design incentive contracts with the managers (Holmstrom and Tirole, 1994) to induce them to report information truthfully, in particular they can fire the managers when the latter are found to have made false reports. These rights give the employee-owners better information than they would get as employees in CFs.[10]

The difference in the information structure between the two types of firms has important implications. In the CF, in bad states when the firm does not perform well, because the uninformed employees are not willing to make wage concessions, such information asymmetry yields a situation where the owner wants to layoff employees, although it is not socially efficient to do so because the worker's investment is firm-specific human capital. In the EOF, however, there is no such information asymmetry[11]and hence no need for inefficient layoffs. In our model, to overcome the moral hazard problem caused by the unobservability of employees' SHC investment, firms monitor their employees and punish those who are found to be shirking in investing. We assume that monitoring results are not verifiable which implies the impossibility of punishing workers contingent on monitoring. Thus, in CFs firing is the only feasible punishment and it cannot be distinguished from layoffs in a verifiable way.[12]The indistinguishability between firing and layoffs, in turn,

makes the owner of the CF unable to commit not to layoff employees.[13]Our major results are summarized in the following.

In the CF, inefficient layoffs reduce the expected payoffs for employees' SHC investment and thus make it more difficult for the CF to induce SHC investment from employees than the EOF, regardless of the size of the firm (Propositions 4 and 5).[14]As a consequence, the CF has to rely more on the use of the stick – a higher monitoring intensity – than the EOF to induce higher SHC investment from workers (Proposition 2); the social welfare associated with the EOF is not lower than that associated with the CF (Proposition 1); and if employees are not subject to a liquidity constraint or if the capital market is perfect, employees are always willing to pay a higher price to buy their firm than outside investors (Proposition 3).

Our key idea is consistent with the empirical finding that when facing exogenous shocks, EOFs are inclined to adjust workers' payments whereas CFs are more likely to adjust employment (Pencavel and Craig, 1994). Our result about the difference in the monitoring intensity between the two types of firms fits well with the observation that EOFs hire fewer managers and they pay their managers less than CFs pay.[15]

We also have some interesting comparative static results. Propositions 6-8 show that the advantages of the EOF over the CF will be larger if: (i) the reservation utility is lower; (ii) the productivity is more uncertain; (iii) the monitoring cost is higher; or (iv) the cost of investment is higher. Result (i) may shed some light on the fact that more EOFs are in the professional service sector if one believes that human capital in the professional service sector is more firm specific thus employees' outside options are lower.[16]Result (ii) may explain why there are more EOFs in industries which are characterized by high fluctuations in profitability (e.g. plywood and construction) (Bonin, Jones, and Putterman, 1993) and why EOF formation is higher than CF formation when the unemployment rate is high (Ben-Ner, 1988). Result (iii) seems to be consistent with the fact that many R&D firms are owned by researchers in the firm.

While keeping the privatization issue in mind and in order to make our theory more convincing and more interesting, the workers in our model pay the competitive price, which is the profit of the firm under the CF, to convert the firm into an EOF. That is, in our model all the advantages that the EOF may have over the CF are derived under this condition.

Moreover, we show that the price which workers are willing to pay for a firm for which they are working is always higher than that which potential outside owners are willing to pay.

We think that our theory is complementary to those which study other aspects of the EOF and particularly those that study the shortcomings of the EOF. Our goal in this paper is to offer a rigorous explanation of one advantage of employee ownership, i.e., its positive effect on employees' incentives for SHC investment (as a comparison, e.g., Hart and Moore (1998) deal with *ex ante* project investment decision; Bolton and Xu (1998) discuss how ownership and competition affect employees' incentives in making human capital investment when monitoring is not possible). Following a large literature on labor contracts (e.g. Hart, 1983), in our model, a worker's effort is made to invest in firm-specific human capital. Therefore, when a worker leaves the firm, his investment is of no value to the firm, nor to the worker. This is the reason why separation (of the worker from the firm) decisions have important efficiency implications. Our paper also sheds light on a number of empirical observations discussed above in a coherent fashion.[17]

The rest of the paper is organized as follows: Section 2 discusses production technology and monitoring common to both ownership forms. Sections 3 and 4 set up models for the CF and the EOF respectively. Section 5 compares the two types of pure ownership. Section 6 performs comparative statics analysis. Finally, section 7 sets forth the conclusion and discusses policy implications of our theory on privatization, particularly implications for the voucher approach.

2 Productivity and Monitoring

In our model, an individual worker's productivity, Y, is stochastically determined by his/her effort to invest in firm-specific human capital. In the remainder of this paper, we will use the terms "effort" and "investment" interchangeably, and we denote the effort to invest in SHC by e.[18]For simplicity, we assume that Y has a symmetric probability distribution. Specifically, for each worker, there are three states: G (good), A (average), and B (bad).[19]In state A, Y is normalized to be the effort level, e. In state G, Y is $(2-\alpha)e$, where $\alpha \in (0,1)$. In state B, Y is αe. The probabilities of G, A, and B are q_2, q_1, and q_2 respectively.[20]In

summary,

$$Y = \begin{cases} (2-\alpha)e & \text{with probability } q_2 \\ e & \text{with probability } q_1 \\ \alpha e & \text{with probability } q_2, \end{cases}$$

The expected productivity then is

$$E\{Y\} = q_2(2-\alpha)e + q_1 e + q_2 \alpha e = e.$$

The worker's von Neumann-Morgenstern utility function is

$$w - d(e),$$

where w is the income and $d(e)$ is the disutility of effort in investing (or cost of investment). The worker's reservation utility is $\underline{w}$, the expected utility from opportunities outside of the firm. To simplify the exposition, we assume that there are two effort levels: e_H (high effort) and e_L (low effort), where $e_H > e_L$. The corresponding disutilities are $d_H = d(e_H)$ and $d_L = d(e_L)$, respectively, where $d_H > d_L$. We assume that

$$e_H - d_H > e_L - d_L$$

so that e_H is the first-best effort level.

We consider the special case that $\alpha e_i \geq \underline{w}$, for $i = H, L$, that is, even in the worst state of the world, the productivity of a worker is higher than his reservation utility, $\underline{w}$.[21]Therefore, it is never socially efficient to lay off a worker.

Without monitoring, the effort of a worker is not observable to the firm, nor is his individual productivity. Only the state of the world is observable to the firm. Under such an environment, there are few incentives for a worker to exert effort. To alleviate the incentive problem, firms employ managers to monitor workers randomly and to punish workers who are found shirking. The cost of monitoring is $c(p) = cp$, where the monitoring intensity p is the probability that a worker is monitored and c is a positive constant. When monitored, a worker is found either to be working hard or to be shirking and is found to be shirking with probability $r(e)$, a function of the effort level. Denote $r_H = r(e_H)$ and $r_L = r(e_L)$. We assume that $r_H = 0$ and $r_L \in (0, 1)$; a hard-working employee is never mistakenly found to be shirking but a shirking worker may with a positive probability mistakenly be

found to be working hard. That is, monitoring is imperfect. Given the widely accepted property that effort cannot be objectively measured, it is inevitable that the monitoring of effort essentially involves subjective evaluation. Therefore, because monitoring results are not verifiable before a court of law, it is impossible to enforce contracts contingent on such results. Summarizing the above discussion, we make the following assumption:
Assumption 1: *The monitoring signal is not verifiable thus not contractible.*

In the next two sections, we use the model to analyze two types of firms: capitalist firms and employee-owned firms.

3 Capitalist Firms

The objective of the CF is to maximize its expected profit. The assumption about the timing of events in the CF is briefly given as follows, with more explanations offered later in this section: (1) The firm and the workers sign a contract specifying a wage and a monitoring intensity, p. We assume that the firm can commit to its choice of p over time.[22](2) The workers choose high or low investment in firm specific human capital. (3) The firm monitors the workers and gets signals about their investment levels. (4) The state of the world is realized and observed by the firm, but not the workers. (5) The firm decides whether to retain the workers. (6) If a worker is retained, the promised wage is paid and the firm gets whatever output is associated with the earlier investment in human capital and the realized state of the world; but if the worker is not retained, there is no wage payment and the firm gets output worth zero.

We assume that, in the CF, there is asymmetric information about the state of the world; only the firm knows it, not the worker. Following Grossman and Hart (1986) and Hart and Moore (1990), we identify ownership with residual rights of control, including the rights to audit the manager's report, to fire the manager for false report, and the participate in the management of the firm. The right to audit is not contractible and hence is a residual right of the owners (Grossman and Hart, 1986) because when and what to audit and under what condition may be too complicated to be fully specified in a contingent contract ex ante. Thus, only the owners have the right to decide when and what to audit under some unspecified contingencies, such as based on his/her own observations while participating in

the management of the firm or based on managers' reports. In the CF, only the capitalist owners have the right to audit the manager and to fire the manager if they find the manager to be misrepresenting the performance of the firm. Such threats make the manager report the truth to the owners.[23]The employees, however, do not have such rights and are not guaranteed true information about the firm. Thus, there is no ground for employees to trust the information as provided by the firm.[24]

With this asymmetry in information, enforceable wage contracts cannot be based on the state of the world; and a worker will not be willing to accept a lower wage when the state of the world is bad. According to Assumption 1, nor can the wage be contingent on monitoring results. Therefore, only a fixed wage can be enforced.[25]

Let us first discuss the case where the firm chooses to induce a high effort, e_H. Under our specification of the monitoring technology, when the monitoring indicates a worker to be shirking, the correct inference is that the worker is indeed shirking. Since wages cannot be contingent on monitoring results and thus it is impossible to punish the worker by reducing his/her wage, the only feasible punishment is to fire the worker.

At the same time, firing must be a credible threat. To highlight our main idea, we restrict ourselves to the case in which the parameters of the model are such that the optimal wage for inducing the high effort, w_H, is greater than the highest possible productivity of the worker from the low effort; i.e. $w_H > (2-\alpha)e_L$.

In this case, it is subgame perfect for the firm to fire a worker when monitoring indicates shirking. Meanwhile, when monitoring indicates a worker to be working hard, the firm's belief that is consistent with equilibrium strategies,[26]is that the worker is indeed working hard. Consequently, the firm will not fire the worker. Therefore, given a worker's effort level, e, and the monitoring intensity chosen by the firm, p, the probability that the worker is not fired is $1 - pr(e)$.

A worker will be laid off when his productivity is lower than the fixed wage. For simplicity, we restrict ourselves to the case in which the optimal wage offered by the firm is between αe and e.[27]Therefore, the worker will be laid off in the worst state of the world. This asymmetry in information, together with the nonverifiability of the monitoring signal (Assumption 1), imply that the distinction between firing and layoff is not verifiable, which is often assumed by labor economists. The common justification of this assumption is that

when the firm wants to layoff a worker, it can always make the worker's job of impossibly difficult so that an excuse can be found to fire the worker. Given the nonverifiability of the distinction, the firm cannot commit not to layoff workers. Otherwise, the firm has to commit also not to fire anyone, which will eliminate all incentives for the worker to exert effort.

If the high effort is induced, the firm's expected profit is

$$\begin{aligned}\pi &= \{[(2-\alpha)e_H - w]q_2 + (e_H - w)q_1\} - c(p) \\ &= [\beta(q)e_H - w]q - c(p),\end{aligned}$$

where

$$\beta(q) = \alpha + \frac{1-\alpha}{q}.$$

and $q = q_1 + q_2 \in (0,1)$ is the probability that the state of the world is not the worst one, i.e. the probability of a worker not being laid off. Alternatively, q can also be interpreted to be a measurement of the stability of productivity. In fact,

$$Var\{Y\} = 2(1-\alpha)^2(1-q)e^2;$$

the fluctuation in productivity is a decreasing function of q. Decreasing q performs a mean-preserving spread to the distribution of productivity. Note that a worker's investment is human capital and therefore is of no value to the firm when the worker leaves the firm.

The expected utility of the worker is

$$u = \underline{w} + (w - \underline{w})q[1 - pr(e)] - d(e),$$

where, w is the wage if a worker is not laid off or fired and $\underline{w}$ is the reservation utility. Also note that the worker's investment in human capital is firm specific thus is of no value to the worker either when he leaves the firm. Therefore, $\underline{w}$ is independent of the worker's investment. The maximal profit the firm can expect is

$$\begin{aligned}\pi(e_H) = \max_{w,p} \quad & (\beta e_H - w)q - c(p) && (C) \\ s.t. \quad & 0 \le p \le 1 \\ & w \ge \underline{w} \\ & (w - \underline{w})q - d_H \ge 0 && (IR) \\ & (w - \underline{w})q - d_H \ge (w - \underline{w})q[1 - pr_L] - d_L && (IC)\end{aligned}$$

The feasible region is given in Figure 1.

Figure 1

The solution to the firm's optimization problem is characterized by Lemma 1.

Lemma 1: *When implementing a high-effort level,*

(1) the optimal monitoring intensity, p^*, optimal wage level, w, and expected profit level, $\pi(e_H)$ will be the following:

$$p^* = \min\{1, p', p''\}$$

$$w = \underline{w} + \frac{\lambda}{p^* q},$$

$$\pi(e_H) = (\beta e_H - \underline{w})q - \frac{\lambda}{p^*} - cp^*$$

where

$$p' = \frac{\lambda}{d_H},\ p'' = \sqrt{\frac{\lambda}{c}},\ \text{and}\ \lambda = \frac{d_H - d_L}{r_L};$$

(2) the incentive compatibility constraint, (IC), is binding.

Proof: See the Appendix.

λ in the lemma is a measurement of monitoring noise. Its range is $(0, \infty)$. As monitoring becomes more accurate, the probability that a shirking worker is found to be shirking, r_L, increases and hence λ decreases.

There are three cases in Lemma 1: (i) (IC) is the only binding constraint and $p < 1$, i.e. $p'' \leq p'$ and $p'' \leq 1$; (ii) both (IC) and (IR) are binding, i.e. $p'' > p'$ and $p' < 1$; and (iii) (IC) is binding and $p = 1$. In the remainder of this paper, to highlight our main idea, we restrict our attention to the first case. This amounts to assuming that

$$\sqrt{\lambda c} \geq d_H. \tag{1}$$

The assumption holds when the monitoring cost, c, or the noise of monitoring, λ, is large, or d_H is small. Under the assumption,

$$\pi^c(e_H) = (\beta e_H - \underline{w})q - 2\sqrt{\lambda c}, \tag{2}$$

$$p^* = \sqrt{\frac{\lambda}{c}}, \tag{3}$$

$$w = \underline{w} + \frac{\lambda}{p^* q}. \tag{4}$$

Now we consider the case where the firm chooses to implement the low-effort level. When the firm does not implement the high effort, no monitoring is needed.[28]As a result, no worker will be fired and, consequently, it is possible for the firm to commit not to lay off workers. To satisfy the individual rationality constraint of the workers, the firm offers a wage

$$w = \underline{w} + d_L.$$

The resulting profit of the firm is

$$\pi^c(e_L) = e_L - \underline{w} - d_L. \tag{5}$$

The CF chooses to implement the high effort or the low effort depending on which of the corresponding profit levels, $\pi^c(e_H)$ or $\pi^c(e_L)$, is larger. The maximum profit of the CF is

$$\pi = \max\{\pi^c(e_H), \pi^c(e_L)\}.$$

4 Employee-Owned Firms

Now let us consider the EOF. The assumption about the timing of events in the EOF is briefly given as follows, with more explanations offered later in this section: (1) The workers buy the firm either from the capitalist owner or from the government (in the case of privatization).[29](2) They hire managers to monitor their effort to overcome the free-rider problem. (3) They collectively choose the quantity and quality of the managers, which determines the monitoring intensity, p.[30] (4) Knowing the choice of the monitoring intensity, workers choose their individual level of specific human capital investment. (5)

The managers monitor the workers and get signals about their investment levels. (6) The state of the world is realized and observed by the managers and the workers. (7) If a worker is found shirking, he will be paid the low reservation wage $\underline{w}$. Otherwise, the worker will share the output of the firm equally with others in the firm.

Assume that the price the employees pay to purchase the firm is π, the value of the firm to the capitalist owner. Also assume that the workers do not have money in their pockets to make the purchase and they have to borrow using the income of the firm as the collateral.[31]We make the following assumption about the repayment of the debt:
Assumption 2: *The worker's income after the debt payment cannot be lower than his reservation utility,* $\underline{w}$.

Otherwise, the worker will leave the firm, because he can receive $\underline{w}$ from other sources. He cannot be forced to pay off this debt from this outside income because it is difficult to verify and/or because it is his subsistence income.

Once again, we first consider the case where the high effort is induced. If monitoring indicates hard work, the correct inference is that the worker is indeed working hard. Then his expected productivity is e_H. Suppose all workers with the same expected productivity receive the same expected payoff. Then the expected payoff to a worker who is not found shirking is $e_H - cp - \pi$. If monitoring indicates shirking, the correct inference is that he is indeed shirking and should be punished. By Assumption 2, the most severe, and thus the optimal, punishment is to pay the worker $\underline{w}$.[32]

The expected utility of the worker exerting effort e is

$$u = \underline{w} + (e_H - \pi - \underline{w} - cp)[1 - pr(e)] - d(e).$$

The worker's expected surplus is

$$\pi = (e_H - \underline{w} - cp)[1 - pr(e)] - d(e).$$

The EOF's problem is to choose a monitoring intensity p to maximize the surplus,

$$\begin{aligned} \pi(e_H) \quad = \quad & \max_p \quad (e_H - \pi - \underline{w} - cp) - d_H & (E) \\ & s.t. \quad 0 \leq p \leq 1 & \\ & \qquad (e_H - \pi - \underline{w} - cp) - d_H \geq (e_H - \pi - \underline{w} - cp)[1 - pr_L] - d_L & (IC) \end{aligned}$$

The solution to the problem is summarized in Lemma 2.

Lemma 2: *When implementing a high-effort level,*

(1) the optimal monitoring intensity, p, and the expected surplus level, $\pi(e_H)$ will be the following:

$$p = \frac{(e_H - \pi - \underline{w}) - \sqrt{(e_H - \pi - \underline{w})^2 - 4c\lambda}}{2c}; \tag{6}$$

$$\pi^l(e_H) = \frac{(e_H - \pi - \underline{w})}{2} + \frac{\sqrt{(e_H - \pi - \underline{w})^2 - 4c\lambda}}{2} - d_H; \tag{7}$$

(2) the incentive compatibility constraint, (IC), is binding.

Proof: See the Appendix.

When the firm chooses to implement the low-effort level, no monitoring is needed and no one will be punished. In this case the surplus of each worker is

$$\pi^l(e_L) = e_L - \pi - \underline{w} - d_L. \tag{8}$$

The EOF chooses the high or low effort depending on whether $\pi^l(e_H)$ or $\pi^l(e_L)$ is higher.

5 A Comparison between the CF and the EOF

In this section, we compare the two types of firms in terms of social welfare, workers' effort level and income, and the monitoring intensity. We do this under the following two assumptions: (1) The production function is the same in the two types of firms; (2) There is no liquidity constraint on the workers; they can always borrow, either from the investors or from the government (in the case of privatization), to purchase the firm. With the first assumption, we abstract away from the potential difficulties for employee-owners to make collective decisions. The second assumption is justified because the worker can use the income of the firm as collateral for the loan and in equilibrium, worker income is enough to repay the loan, as will be shown in Proposition 3.

Before we begin our comparison, let us look at some important features of our model. First, we assume that the employee-owners of the EOF pay the value of the firm to the original owners by borrowing in the capital market. Therefore, the difference in the workers'

income between the two types of firms is not because the workers in the EOF are given the firm for free or because they have more income-producing assets. Second, our results on workers' incentives do not depend on the size of the firm.[33]

Our first result is that the EOF produces at least as much social welfare as the CF. This is because the CF cannot avoid inefficient layoffs caused by asymmetric information about the state of the world, while this problem does not affect the EOF.

Proposition 1: *The social welfare associated with the EOF is at least as high as that associated with the CF.*

Proof: When the CF implements the high effort, it solves

$$\begin{aligned} \pi^c(e_H) \quad = \quad & \max_{w,p} \quad (\beta e_H - w)q - c(p) \qquad (C) \\ & s.t. \quad 0 \leq p \leq 1 \\ & \qquad\quad w \geq \underline{w} \\ & \qquad\quad (w - \underline{w})q - d_H \geq 0 \qquad (IR) \\ & \qquad\quad (w - \underline{w})qp \geq \lambda \qquad (IC) \end{aligned}$$

Let the solution to the above problem be (w, p^c). Now let us consider the EOF's optimization problem when implementing the high-effort level. It solves

$$\begin{aligned} \pi(e_H) \quad = \quad & \max_{p} \quad (e_H - \pi - \underline{w} - cp) - d_H \qquad (E) \\ & s.t. \quad 0 \leq p \leq 1 \\ & \qquad\quad (e_H - \pi - \underline{w} - cp)p \geq \lambda \quad (IC) \end{aligned}$$

We claim that p^c satisfies the incentive compatibility constraint in the program (E). Substituting $\pi = (\beta e_H - w)q - cp^c$ into the left-hand side of the constraint (IC), we have

$$e_H - \pi - \underline{w} - cp^c = e_H - \underline{w} - (\beta e_H - w)q.$$

Rearranging and using the definition of β yields

$$e_H - \pi - \underline{w} - cp^c = (1 - q)(\alpha e_H - \underline{w}) + (w - \underline{w})q. \tag{9}$$

The first term on the right-hand side, $(1 - q)(\alpha e_H - \underline{w})$, measures the inefficiency caused by layoffs. It is non-negative because of our assumption that layoffs are never efficient (i.e.,

$\alpha e_H > \underline{w}$) and it is strictly positive if layoffs occur with positive probability (i.e., $q < 1$). Therefore,

$$e_H - \pi - \underline{w} - cp^c \geq (w - \underline{w})q, \tag{10}$$

that is, with the same monitoring intensity, the expected income of a worker in the EOF is at least as high as that of a worker in the CF.

Since p^c is a feasible choice of the monitoring intensity for the EOF, the social welfare associated with the EOF is at least as much as

$$(e_H - \pi - \underline{w} - cp^c) - d_H + \pi = (1 - q)(\alpha e_H - \underline{w}) + (w - \underline{w})q - d_H + \pi, \tag{11}$$

by equation (9). Therefore, it is at least as much as the social welfare associated with the CF, which is $(w - \underline{w})q - d_H + \pi$.

When the CF implements the low effort, the two types of firms will have the same social welfare if the EOF also implements the low effort. However, this is the least the EOF can achieve with respect to social welfare. It could do better by implementing the high effort.

Q.E.D.

The proof shows that the inefficiency caused by layoffs, $(1-q)(\alpha e_H - \underline{w})$, is the driving force behind our results. This is also important for the other results which we will discuss in the remainder of the paper.

Our second result is that the CF needs a higher monitoring intensity to induce hard work than does the EOF. The reason for this is that the inefficient layoffs in the CF, due to asymmetric information, reduce the payoffs for hard work and thus make it necessary to adopt a higher monitoring intensity to induce the high-effort level.

Proposition 2: *The EOF uses less intense monitoring than the CF when both types of firms implement the high effort.*

Figure 2

Proof: Let p^c and p^l be the monitoring intensity needed for the CF and the EOF, respec-

tively, to induce the effort level e_H. By (10),

$$(e_H - \pi - \underline{w} - cp^c)p^c \geq (w - \underline{w})qp^c.$$

Because the incentive compatibility constraint in the optimization program of the CF is binding (by Lemma 1), the right-hand side of the above equation is λ. In the proof of Lemma 2, we show that p^l is the smaller of the two solutions to the quadratic equation $(e_H - \pi - \underline{w} - cp)p = \lambda$. Therefore,

$$p^c \geq p^l,$$

as illustrated in Figure 2, where $\lambda^c = (e_H - \pi - \underline{w} - cp^c)p^c$.

Q.E.D.

Empirical studies show that there are fewer managers, and these managers are paid less, in the EOF than in the CF. If we regard managers as monitors and we use the salary of the managers to be an indicator of the monitors' quality, then the conclusion of Proposition 2 agrees with the empirical findings.

The next proposition says that employee-owners of the EOF enjoy a non-negative surplus after paying the competitive price for the firm. Therefore, they will always win the competition with the capitalists to buy the firm. Furthermore, if they borrow to make the purchase, the value of the firm is always enough to cover their loan repayment so that they should not face a liquidity constraint if the capital market is perfect.

Proposition 3: *The employee-owners value a firm more than the capitalist owners, i.e.* $\pi^l \geq 0$.

Proof: The value of the firm to the employee-owners is the social welfare produced by the EOF, which is shown to be greater than the social welfare produced by the CF. The latter is the sum of the profit of the CF and the worker's expected income. By the worker's individual rationality constraint, the sum is no less than the profit. Therefore, the value of the firm to the employee-owners is greater than the profit of the firm to the capitalist owners.

Q.E.D.

The next proposition states our main result: The equilibrium effort level in the EOF is never lower than that in the CF. The reason for this is that the payoff to hard work is lower in the CF than in the EOF because of inefficient layoffs in the former. Therefore, it is more difficult to induce hard work in the former than in the latter.

Proposition 4: *The equilibrium effort level is the EOF is never lower than that in the CF.*

Proof: We only need to prove that the EOF will find it optimal to implement the high-effort level, e_H, if the CF does. Suppose the CF implements e_H. Then, $\pi^c(e_H) \geq \pi^c(e_L)$ and $\pi = \pi^c(e_H)$. Rearranging, we have

$$\pi^l(e_H) - \pi^l(e_L) = (\pi^l(e_H) + \pi) - (\pi^l(e_L) + \pi).$$

By (5) and (8),

$$\pi^c(e_L) = \pi^l(e_L) + \pi.$$

Therefore,

$$\pi^l(e_H) - \pi^l(e_L) = \pi^l(e_H) + \pi - \pi^c(e_L) \geq \pi^l(e_H).$$

By Proposition 1, $\pi^l(e_H) \geq 0$. Therefore,

$$\pi^l(e_H) \geq \pi^l(e_L),$$

that is, the EOF should implement e_H.

Q.E.D.

Proposition 5: *The expected income of employees in the EOF is higher than or equal to that in the CF.*

Proof: If the CF implements e_H, then by Proposition 4, the EOF does so also. The employee's expected income is $e_H - \pi - cp^l$ in the EOF and is $(w - \underline{w})q + \underline{w}$ in the CF.

$$e_H - \pi - cp^l > e_H - \pi - cp^c$$

by Proposition 2. The right-hand side of the inequality is greater than $(w - \underline{w})q + \underline{w}$ by (9).

If both the CF and the EOF implement e_L, then the expected income of the employees is $\underline{w} + d_L$ in both types of firms.

If the CF implements e_L and the EOF implements e_H, the expected income of the employees is $\pi^l(e_H) + \underline{w} + d_H$ in the EOF and is $\underline{w} + d_L$ in the CF. The former is greater than the latter because of Proposition 3 and $d_H > d_L$.

Q.E.D.

The above results imply that: (i) in a market economy, if there is no liquidity constraint on the workers or if the capital market is perfect, then the workers will be able and will prefer to buyout the firm; and (ii) in the privatization process, it is efficient to help workers overcome liquidity constraints to allow them to purchase the firms for which they are working.

6 Comparative Statics

In this section, we investigate how the advantages of the EOF over the CF change when there are changes in the reservation utility, the monitoring cost, the productivity uncertainty, and the disutility of the high effort, d_H. Our comparative static results fit the empirical evidence very well. To concentrate on the most interesting case, we again discuss only the case where both types of firms implement the high-effort level.

There are two different measures of the advantages of the EOF over the CF. One natural measure is the gain in social welfare. This is a normative measure; it tells us which ownership should be chosen. The other is the amount by which the employee-owners of the EOF value the firm more than capitalist owners of the CF, the value of π^l. This is a positive measure; it tells us which ownership will win out in the competition to buy the firm. The two measures may be different because the individual rationality constraint in the CF may not be binding such that the capitalist owners of the CF may not be able to expropriate all of the gain in social welfare. The first measure is more important for policy analysis and the second is more relevant for empirical studies.

The first comparative statics result is on the effect of a change in the reservation utility. By (9) in the proof of Proposition 1, $(1-q)(\alpha e_H - \underline{w})$ measures the efficiency loss in the CF caused by inefficient layoffs, which accounts for the advantage of the EOF. This term

decreases with the reservation utility, $\underline{w}$, and the stability of productivity, q. Therefore, we should have the following result:

Proposition 6: *(1)The lower the reservation utility, the more efficient the EOF than the CF and the more the employee-owners value the firm over the capitalist owners.*[34] *(2)The more uncertain the productivity, the more efficient the EOF over the CF and the more employee-owners value the firm over the capitalist owners.*

Proof: The social welfare produced by the EOF is

$$sw^l = (e_H - \pi - \underline{w} - cp^l) - d_H + \pi,$$

and the social welfare produced by the CF is

$$sw^c = (w - \underline{w})q - d_H + \pi.$$

By (11),

$$sw^l - sw^c = (1-q)(\alpha e_H - \underline{w}) + c(p^c - p^l). \tag{12}$$

By (3) and (6),

$$c(p^c - p^l) = \sqrt{\lambda c} - \frac{(e_H - \pi - \underline{w}) - \sqrt{(e_H - \pi - \underline{w})^2 - 4c\lambda}}{2}.$$

Rearrangement yields

$$c(p^c - p^l) = \sqrt{\lambda c} - \frac{2\lambda c}{(e_H - \pi - \underline{w}) + \sqrt{(e_H - \pi - \underline{w})^2 - 4c\lambda}}. \tag{13}$$

The right-hand side is an increasing function of $e_H - \underline{w} - \pi$, which is

$$(1-q)(\alpha e_H - \underline{w}) + 2\sqrt{\lambda c}.$$

by (3), (4), and (9). Therefore $sw^l - sw^c$ is decreasing in $\underline{w}$ and is increasing in the uncertainty about productivity, $(1-q)$.

By (7), π^l is an increasing function of $e_H - \underline{w} - \pi$. Therefore π^l is decreasing in $\underline{w}$ and is increasing in the uncertainty about productivity, $(1-q)$.

Q.E.D.

The size of the reservation utility $\underline{w}$ is closely related to firm-specific human capital. When workers' human capital is firm specific, its value outside of the firm is low; thus the workers will earn less in jobs in other firms. Part (1) of Proposition 6 can then be interpreted as: the more firm-specific the workers' human capital, the more efficient the employee ownership over capitalist ownership.

Part (2) of the proposition implies that, everything else being equal, employee ownership is more likely in sectors where there is more fluctuation in profitability. The plywood industry and the construction industry are such examples (Bonin, Jones and Putterman, 1993).

The next result is on the effort of monitoring costs. In the last section, we showed that the monitoring intensity required for implementing the high effort in the EOF was lower than that in the CF. Thus when the monitoring cost is high, it affects the surplus/profit less in the EOF than in the CF.

Proposition 7: *The advantage of the EOF over the CF, π^l, increases with the monitoring cost, λc.*

Proof: Similar to the proof of Proposition 6, π^l is an increasing function of

$$\alpha(1-q)e_H - (1-q)\underline{w} + 2\sqrt{\lambda c},$$

which is increasing in λc.

Let $\Delta = (1-q)(\alpha e_H - \underline{w})$. Then $e_H - \pi - \underline{w} = \Delta + 2\sqrt{\lambda c}$ by (3), (6), and (9). By rearranging (13), we have

$$c(p^c - p^l) = \sqrt{\lambda c}\left[1 - \frac{1}{1 + \frac{\Delta}{2\sqrt{\lambda c}} + \sqrt{\frac{\Delta^2}{4c\lambda} + \frac{\Delta}{\sqrt{\lambda c}}}}\right].$$

The right-hand side is increasing in λc. Therefore, by (12), the difference in social welfare between the EOF and the CF increases with the monitoring cost λc.

Q.E.D.

This result is consistent with the fact that many R&D firms are owned by researchers in the firm. The complexity of R&D activities makes monitoring very difficult, thus particularly costly.

Proposition 8: *The lower the disutility of the high effort, d_H, the more the employee-owners value the firm over the capitalist owners.*

This result is easy to see from the expression of π^c, which is independent of d_H, and π^l which is decreasing in d_H given π^c. The intuition is that the individual rationality constraint (IR) in the CF's maximization problem is not binding. The smaller the d_H, the larger the slack and the more valuable the firm to the employee-owners. The implication of this result is that, other things being equal, firms in industries with better working environments, such that working hard is less uncomfortable, are more likely to be owned by employees. Possible examples are professional service firms and R&D firms.

7 Conclusion

This paper contributes to an understanding of employee ownership by providing a model to show that the free-rider problem does not render employee ownership ineffective as a means of motivating employees; employee ownership may encourage workers' effort to invest in firm-specific human capital even for large-size firms. In fact, our results do not depend on the size of the firm. This is in sharp contrast to the suggestions of some economists (e.g. Alchian and Demsetz, 1972) and seems consistent with the empirical evidence.[35]A comparison between the two types of firms depends rather on parameters such as human-capital specificity, productivity uncertainty, monitoring costs etc. Our results also provide suggestions for further empirical research on the EOF.

Some qualifications to our theory are in order. First, our theory concentrates on one important aspect of the firm: the workers' effort of investing in specific human capital. There are other aspects which may also affect the efficiency of a specific ownership form. In the literature, it is argued that, given the imperfection of the capital market, it is more costly for the EOF to raise capital than the CF (Jensen and Meckling, 1979).[36]It is also believed that collective decision making in the EOF is more difficult than managerial decision making in the CF (Hansmann, 1996). If these two elements are considered as extra costs for the EOF, our theory may shed some light on the conditions required for the existence of the EOF in market economies.

Second, workers are assumed to be risk neutral in our model. Otherwise, there are some

risks which lower the welfare of workers in the CF, such as risks related to layoffs. However, there are other risks which lower the welfare of workers in the EOF, such as risks related to variations in the income of workers, or the nondiversified assets of workers. The addition of such risks into our model will make it much messier without adding to our understanding.

Third, to keep our model manageable, we do not analyze the conflicts between owners and managers. To understand large firms, where the separation of ownership and control is prevalent, in future work it will be important to analyze such conflicts explicitly. However, we want to point out that under the conditions of our model, owners and managers share the information about the firm. Thus, owners of both types of firms can always put managers into incentive schemes such that they are motivated to work hard to monitor workers.[37]This implies that with respect to the motivating of managers, there is no difference between the CF and the EOF. This reasoning is different from that of Alchian and Demsetz (1972), who argue that due to the inability of the EOF to solve the ultimate monitoring problem, the CF will be superior at least when the size of the firm is large. This is because the owner of the CF, as the ultimate residual claimant, is highly motivated.

Fourth, given the information structure in this model, ex post renegotiation about wage, the firing decision, and the layoff decision will be complicated, and renegotiation results will be sensitive to specific structures of renegotiation games. To highlight our points and to avoid complication, we do not consider renegotiation in our model. The analysis of such renegotiation awaits for future research.

Our model has some implications for privatization. In our formal model, the owners of the EOF have to pay the competitive price for the firm, which is the profit of the firm under the CF. Using a slightly modified version of our model where the workers pay a fixed price, it is easy to show that the relative efficiency of the EOF depends on the price that the workers pay for the firm. The lower the price, the more efficient the EOF. This is because a lower price gives the workers a higher income and thus makes it less costly to induce effort. In this respect, our theory justifies the approach of giving vouchers to workers in the privatization process.[38]This approach to privatization has been practiced in Russia and some Central Eastern European countries. It is also an option to consider for the reform of state-owned enterprises in China.[39]Of course, in evaluating different privatization schemes, one should also consider their effect on the firm's future ability to raise capital, which is

an important issue that we do not consider in our paper.

In summary, our model shows that employee-ownership has a positive effect on workers' incentives for investing in SHC even for large firms. Furthermore, we offer a coherent explanation for a number of important empirical observations. Finally, our model is potentially useful for studying mixed ownership such as employee stock-ownership plans and profit sharing schemes as well as for policy analysis.

Appendix

Proof of Lemma 1: Constraint (IR) implies that $w \geq \underline{w}$. Constraint (IC) can be rearranged as

$$(w - \underline{w})qpr_L \geq d_H - d_L.$$

Because $w \geq \underline{w}$, the above inequality implies that $p \geq 0$. The objective function is decreasing in p and w. Therefore, (IC) is binding. The boundaries (IR) and (IC) intersects at

$$p' = \frac{d_H - d_L}{d_H r_L}.$$

Let us first solve the following optimization problem

$$\begin{array}{rcll} \pi(e_H) & = & \max_{w,p} & (\beta e_H - w)q - c(p) \qquad\qquad (OP - IC) \\ & & s.t. & p \leq 1 \\ & & & (w - \underline{w})qpr_L = d_H - d_L \qquad\qquad (IC) \end{array}$$

¿From (IC), we can solve for w.

$$w = \underline{w} + \frac{\lambda}{pq}. \tag{14}$$

Substituting (14) into the profit function and rearranging, we have

$$\pi(p) = (\beta e_H - \underline{w})q - \frac{\lambda}{p} - cp. \tag{15}$$

Differentiate π with respect to p. Then

$$\pi'(p) = \frac{\lambda}{p^2} - c.$$

The critical point of π is

$$p'' = \sqrt{\frac{\lambda}{c}}.$$

Because $\pi''(p) < 0$, the solution to the optimization problem (OP- IC) is

$$p = min\left\{1, \sqrt{\frac{\lambda}{c}}\right\}.$$

This is also the solution to the original optimization problem when $p' \geq p''$. When $p'' > p' \geq 1$, the optimal p is 1. When $p'' > p'$. and $p' < 1$, π is increasing in p along the (IC) boundary of the feasible region. π is decreasing along the (IR) boundary of the feasible

region because along this boundary w decreases with p. Therefore, the optimal p here is the intersection of the two boundaries, i.e. $p^* = p''$. In summary, the optimal monitoring intensity is given in the Lemma.

Given that constraint (IC) is always binding, we have the optimal wage offer w. Substituting the solution of p^* and w into the profit function, we have $\pi(e_H)$.

Q.E.D.

Proof of Lemma 2: The constraint (IC) can be rearranged as

$$(e_H - \pi - \underline{w} - cp)pr_L \geq d_H - d_L.$$

The above inequality implies that $p \geq 0$. The objective function is decreasing in p. Therefore (IC) is binding. The optimal p is the smaller of the two solutions to the quadratic equation

$$(e_H - \pi - \underline{w} - cp)p = \lambda,$$

that is[40]

$$p = \frac{(e_H - \pi - \underline{w}) - \sqrt{(e_H - \pi - \underline{w})^2 - 4c\lambda}}{2c}.$$

The expected surplus is

$$\pi(e_H) = e_H - \pi - \underline{w} - d_H - \frac{(e_H - \pi - \underline{w}) - \sqrt{(e_H - \pi - \underline{w})^2 - 4c\lambda}}{2}.$$

Rearranging, we have

$$\pi(e_H) = \frac{(e_H - \pi - \underline{w})}{2} + \frac{\sqrt{(e_H - \pi - \underline{w})^2 - 4c\lambda}}{2} - d_H.$$

Q.E.D.

Footnotes:

2. According to the well-known "Coase theorem," ownership should not matter as long as bargaining among involved parties is efficient.

3. In the US, the service professions are dominated by EOFs; taxicab companies in large cities are frequently employee-owned; UAL, one of the largest airlines in the world, was transformed into an EOF in 1994; in Sweden all taxicab services and 50% of the truck transport services are provided by EOFs; in Israel, almost all of the bus transportation and half of the truck transport are provided by EOF (Hansmann, pp.67-69).

4. In the U.S., by 1990 about 10,000 companies adopted the ESOP and the majority of the stock of more than 1,000 of these companies was owned by the ESOP (Hansmann, 1996, p.105). In Japan, 91 percent of all firms listed on the Japanese stock market had an ESOP in 1989 (Jones and Kato, 1995). In the U.K. employees in 43 percent of the firms shared profits in 1990 (Bhargava, 1994).

5. In Russia and in Central Eastern Europe, "the vast majority of East European privatization has involved transfers to employees of the formerly state-owned company." (Earle and Estrin, 1995, p.40). (Also see Blasi, 1994; Boycko, Shleifer, and Vishny, 1993, for Russia). In China, without massive privatization, the township-village enterprise (TVE) shares important features with EOFs (Gelb and Svejnar, 1990; Chen, 1992; Pitt and Putterman, 1993; Weitzman and Xu, 1994; Smith, 1995). Moreover, in the recent ownership reform process many TVE's have been formally transformed into EOFs (Weitzman and Xu, 1994; Smith, 1995). Finally, a survey from several provinces in China finds that cooperatives accounts for 35 percent of all privatization of state-owned enterprises (Cao, Qian, and Weingast, 1997).

6. Hart and Moore (1994) also argue that employee ownership reduces the inefficiencies caused by market power.

7. Bolton and Xu (1998) also show that restricting employee ownership to good employees (partnership) may induce better incentives for employees to invest in human capital.

8. Meade (1972) provides such an argument. Fitzroy and Kraft (1986) discuss the role of peer-pressures, which is especially hard to understand for large firms. MacLeod (1984, 1988), Weitzman and Kruse (1990) study the role of cooperative culture in the EOF. However, it is not clear why similar cooperative culture cannot be cultivated in the

CF. Bowles and Gintis (1993, 1996) and Dow (1993a) argue that capitalist owners choose inefficient production decisions because they fail to internalize the workers' costs or benefits. This argument is no longer valid if a performance bond is introduced so that the worker's participation constraint becomes binding.

9. Jones and Kato, 1995 for Japan; Bhargava, 1994 for the U.K.; Fitzroy and Kraft, 1987 for Germany; and Weitzman and Kruse, 1990 for the U.S. and in general.

10. The practice of the German co-determination scheme also illustrate how likely asymmetric information is generated when employees are not owners. It is reported that most German corporations under the co-determination scheme did not distribute auditors' report to the union representatives in the board although it is required by the law to disseminate this information to the employees (Pistor, 1997).

11. Although profit sharing does not necessarily mean sharing ownership, several independent opinion surveys find that in firms which are implementing profit-sharing employees share significantly more information about the firm than employees who are in firms which are not implementing profit sharing (Weitzman and Kruse, 1990).

12. Here we take the difference in the extent of information asymmetry between the two types of the firms to the extreme by assuming that there is no information asymmetry about the profitability of the firm in employee-owned firms. We believe this only simplifies the exposition.

13. In this paper, we use "firing" to mean severing the employment relationship with the worker for his shirking and "layoff" to mean severing the relationship when the firm faces a bad state, e.g., adverse market conditions.

14. Note that group incentives and relative performance evaluation studied by Holmstrom (1982) do not work well when individual performances are difficult to observe and there is asymmetric information about the output of the team, as is assumed in our model.

15. In our model, the employee-owners of an EOF have to pay a price for ownership; their expected payoff is higher than the payoff to workers in the CF not because they are given a free gift, but because in the EOF there are no inefficient layoffs.

16. It has been discovered that (a) EOFs use a significantly smaller number of supervisors/managers than CFs in the same industry and same location (Greenberg, 1986); (b) the salary ratio between managers and workers in the CF is 75 percent higher than that in

the EOF (Bartlett, 1992). Also see Craig and Pencavel, 1992.

17. Hansmann, 1996; Craig and Pencavel, 1992; Bonin, Jones, and Putterman, 1993. Different explanations are also provided focusing on problems related to the collective decision making of owners (Hansmann, 1996; and Hart and Moore, 1998) and on problems related to *ex ante* human capital investment decision (Bolton and Xu, 1998).

18. A recent survey points out that there is no well-specified theoretical model which guides the empirical work in this field (Bonin, Jones, and Putterman, 1993).

19. To focus on the issue of incentives, we assume constant returns to scale technology. Moreover, we assume that capital is a perfect complement to the number of employees, i.e. not an independent variable, but is independent of the SHC investment of the employees. These assumptions allow us to simplify our model. Further study needs to be done for more general production technology.

20. More precisely, the state of the firm is described by $s = (n_G, n_A, n_B)$, with $n_G + n_A + n_B = n$, the number of workers in the firm, where n_i is the number of workers with state i, for $i = G, A, B$. Given s, individual worker's state is assigned randomly conditional on s. In this sense, the state is firm specific, but not worker specific.

21. We assume a special discrete distribution of the worker's productivity because it is very difficult to derive comparative statics results if we assume a continuous distribution. See Bai and Wang (2000).

Both α and q could depend on e. The results will not change.

22. For the sake of simplicity, we assume that SHC investment, monitoring, and state revelation all occur in a negligible length of time so that the same reservation utility can be used in different cases. Our proof that this assumption is not essential for the qualitative results is available upon request.

23. We can view p as a measure of the quantity and quality of managers hired by the firm to monitor the work. It is very costly for the firm to change the value of p.

To highlight the incentive problem of workers, we abstract away from the managers' agency problem. The robustness of our results with respect to this is discussed in the conclusion.

24. To highlight our point, our assumption is in extreme. In fact, as long as the owners know more than their employees, our results will hold. We recognize the possibility that

even under the threat of being fired for misrepresenting information, the manager still may not tell the owners the truth all of the time. However, it is impossible to conceal information from the owners without doing the same to the employees.

25. For example, under an unexpected good state, the firm has made an unexpected high profit. The firm might use the profit for a new project instead of sharing it with the employees. Expecting such behavior, employees do not make wage concessions in real bad states.

26. There are complicated mechanisms that can be used to induce truth-telling by the firm to the employees. An example of such a mechanism is for the firm to link the wages to the total number of workers served in the firm. For simplicity and clarity, we do not consider those mechanisms. However, our result would still hold even if we considered them since there are inefficient involuntary layoffs or underemployment in all such mechanisms as discussed in the literature, such as Grossman and Hart (1983).

Other possible incentive schemes in the CF are ruled out by the assumptions of the model: the nonobservability of individual performance makes tournament competition impossible; the asymmetric information in the CF makes a bonus incentive scheme not feasible. Given that workers do not know their productivity, the owner has an incentive not to pay the bonus which links a worker's productivity to the bonus.

27. Recall that we are considering the case where the firm chooses to induce the high effort; the equilibrium strategy of the worker is to exert high effort.

28. This is equivalent to assuming that $\alpha e_H < \underline{w} + \frac{\sqrt{\lambda c}}{q} < e_H$, as can be seen when we solve the firm's optimization problem.

29. Because it is easy to monitor low effort, it is wasteful to hire specialized managers for monitoring.

30. Our results do not depend on the assumption that the workers have to purchase the firm, and they will be strengthened if the workers are endowed with the ownership.

31. To highlight the incentive problem of the workers, we again abstract away from the managers' agency problem. The robustness of the results in this respect is also discussed in the conclusion. The workers are assumed to be homogeneous so that collective decision making is not a problem.

32. To highlight our points, we do not model the collective decision making problem.

However, our model is consistent with majority voting with homogeneous workers. Concerning the value of the firm, in the simplest model which has only one period, the value of the firm under a given ownership is the same as the income of the firm.

33. It is not efficient to fire the worker here, because $\alpha e_L \geq \underline{w}$ and workers in the EOF will not abuse the punishment to pay their hard-working colleagues $\underline{w}$. Even if such abuse cannot be excluded, our results remain since given the homogeneity of the workers in our model all workers have the same probability of being abused and they also have the same probability of being the abuser.

34. In the existing literature, the argument in favor of the EOF depends on assuming the firm to be small-sized, whereby each worker has some incentive to work hard because he/she received a nontrivial share of the return to his effort. When the size of the firm is large, free riding becomes too severe and as a result such an argument is no longer valid.

35. Putterman and Skillman (1992) prove a similar result but in a very different way.

36. A recent survey suggests that in studies of real world EOFs shirking by workers, which is implied by Alchian and Demsetz (1972), is never reported as a concern (Bonin, Jones, and Putterman, 1993).

37. If employees are able to pay cash or vouchers (in the case of privatization) to buy the assets of the firm, then the adverse effect of the imperfections of the capital market on the EOF will disappear.

38. In the case of a large firm where there are many employee-owners who are supposed to monitor the manager, the employee-owners can put the manager on an incentive contract and at the same time they can hire independent auditors to monitor the manager. Since independent auditors work for many people, they are concerned about their reputations. This will ease the agency problem.

39. Our theory is valid to explain the advantages of the voucher system when privatized firms are controlled by employees, although the voucher system allows workers to diversify their assets when they are "purchasing" the firms.

40. We acknowledge that in Russia and in the East European countries there are many serious problems which were inherited from the old system. Our understanding is that it is these inherited problems, not the employee-ownership, which create troubles for the privatized firms. Further discussion of these problems is beyond the scope of this paper.

41. We assume that $\frac{(e_H-\pi-\underline{w})-\sqrt{(e_H-\pi-\underline{w})^2-4c\lambda}}{2c} \leq 1$.

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