

Does Employee Ownership Improve Incentives For Efforts?

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Abstract

This paper provides a theoretical framework to analyze workers' incentives under different ownership. It shows that the workers' effort and expected income are higher and the monitoring intensity is lower in the employee-owned firm than in the capitalist firm. Unlike in previous models, the advantage of employee ownership here does not depend on the size of the firm. It also shows that the advantage of employee ownership increases as workers' reservation wage decreases, the monitoring cost and productivity uncertainty increases. Finally, it discusses the relevance of the theory to employee stock-ownership program (ESOP) and profit sharing.

JEL classification: J54, D23.

Key Words: employee ownership, incentives, effort.

1 Introduction

When should a firm be owned by outside investors, and when should a firm be owned by inside members (employees)? This is one of the oldest and most important questions in economics.¹ Many theoretical and empirical investigations have been conducted concerning this question. However, economists are still far from providing satisfactory theories on this fundamental issue (Bonin, Jones, and Putterman, 1993; Hansmann, 1990, 1994). In addition to intellectual interests, providing theoretical answers to the question also has important policy implications on issues related to the growing acceptance of profit sharing and ESOP in market economies, and recent unexpected important developments in privatization in transitional economies.

In market economies, there are outside investors owned capitalist firms (CF) and insiders owned employee-owned firms (EOF).² (Hansmann, 1988, 1990; Craig and Pencavel, 1992; Bonin, Jones, and Putterman, 1993). Some of the EOFs are quite large³ In addition to pure cases of CFs and EOFs, there are many firms with mixed ownership, such as employee stock- ownership plans (ESOP) and profit sharing schemes in many CFs. Moreover, recently, more firms in market economies are adopting ESOPs and profit sharing.⁴

In the massive privatization process in Central Eastern Europe and former Soviet Union republics, instead of being transformed into typical capitalist firms, which was the goal of the privatization, “the vast majority of East European privatization have involved transfers to employees of the formerly state-owned company.” (Earle and Estrin, 1995, p.40).⁵ Similar discoveries have also been reported by others (Blasi, 1994, Boycko, Shleifer, and Vishny, 1993, for Russia).

Without massive privatization, elements of employee ownership has also played important roles in China’s economic reform. The Chinese township-village enterprise (TVE), which is the most dynamic sector of the Chinese economy, share important features with employee-owned firms (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).

In light of these development, it is important for economists and policy makers to understand the advantages, disadvantages, and major features of employee ownership *vis-a-vis* outside ownership. The experience of employee ownership *vis-a-vis* outside ownership in market economies provides some clue. Theoretical modeling is a necessary complement to provide deeper understanding.

Important features of the EOF in market economies, which are closely related to our question, are reported as follows: (1) Employee ownership, or at least elements of employee ownership, such as ESOP or profit sharing, seems improve productivity;⁶ (2) Compared with their CF counterparts, EOFs hire smaller number of managers and pay them less (Bartlett, 1992; Greenberg, 1986; Craig and Pencavel, 1992).⁷ That is, the monitoring intensity in the EOF is lower than that in the CF; (3) EOFs are concentrated in some industries, such as (a) professional service

¹According to the well known “Coase theorem”, ownership should not matter as long as bargaining among involved parties is efficient.

²It should be clear that comparing with the state- owned firm, both the CF and the EOF are privately-owned firms. Moreover, comparing with centralized economy which is organized as a single firm, both the CF and the EOF are independently operated firms with a limited size and limited liability. Further discussion on these issues is beyond the scope of the paper.

³For example, UAL in the US, one of the largest airlines in the world, was transformed to a EOF in 1994. The Clinton Administration has shown strong encouragement to the conversion of troubled capitalist firms into labour-managed firms. (*New York Times*, July 13, 1994).

⁴In Japan, 91% of all firms listed on Japan stock market have an ESOP (Jones and Kato, 1995). In America and in Europe, XXXX% of CFs have an ESOP and XXXX% of CFs have profit sharing schemes.

⁵Specifically, till 1994, about 90 percent of all large privatized firms in Russia, 75 percent of privatized firms in Poland, and 98 percent of all large privatized firms in Romania, and a large percent (about 43 percent) of privatized firms in Hungary are converted into EOFs (Earle and Estrin, 1995, Table 1).

⁶Evidence for EOF (Bonin, Jones, and Putterman, 1993); evidence for ESOP and profit sharing from Japan (Jones and Kato, 1995); UK (1994 (*Economic Journal*)); Germany (Fitzroy and Kraft, 1987); US .

⁷It is discovered that (a) EOFs use a significantly smaller number of supervisors/managers than the CFs in the same industry and same location (Greenberg, 1986); (b) the salary ratio between managers and workers in the CF is 75% higher than that in the EOF (Bartlett, 1992).

industry (Hansmann, 1988, 1990; Craig and Pencavel, 1992; Bonin, Jones, and Putterman, 1993), or (b) industries which are characterized by high fluctuation in profitability (e.g. plywood and construction) (Bonin, Jones, and Putterman, 1993); and (4) EOF formation is higher than CF formation when the unemployment rate is high (Ben- Ner, 1988).

In the literature, some theories have been provided to explain some of the above listed features. Concentrating on problems related to collective decision making of owners, Hansmann (1988, 1990) and Hart and Moore (1994) explained the above feature (3a).⁸ However, to our knowledge, problems related to efforts and incentives of workers, have never been sufficiently analyzed in theory.⁹ Some casual arguments have been made to conclude that employee ownership mitigates the moral hazard problem associated with unobservable efforts, but these arguments are either based on the assumption that the size of the firm is very small or offered without the rigor of theoretical modeling, which would not be able to offer rich results to explain the observed features of the EOF. Moreover, there is no theory which explains many of the above listed features simultaneously.

In this paper, we present a theory which shows that employee ownership could provide stronger incentives for employees to work hard, even when the size of the firm is large, and it explains the above listed features all together in a coherent way. We explicitly analyze monitoring issues when efforts of workers in both types of firms are unobservable and unverifiable. Our theory is complementary to existing theories, particularly the ones which explain disadvantages of the EOF. Prominent disadvantages of employee ownership discussed in the literature include difficulties for employee-owned firms to raise capital (Jensen and Meckling, 1979; Dow, 1993); inefficient collective decision making due to heterogeneity of employee owners' preferences (Hansmann, 1988, 1990); and the free-rider problem in the EOF, particularly when the size of a EOF is large (Alchian and Demsetze, 1972).¹⁰ The early literature on the labor-managed firm (LMF) concentrate on the adverse effects of the different objectives of the LMF (Ward, 1958; Domar, 1966; Vanek, 1970; Meade, 1972).

Our theory is based on the observation that the owner of a firm has residual rights of control, including the right to audit the manager's report and the right to alienate the assets of the firm from the manager when the manager is found to have made false reports. Such rights give the owner better information about the performance of the firm than other stakeholders, except for the manager. In the capitalist firm, such information asymmetry yields situations where the owner wants to layoff employees when the firm does not perform well although it is not socially efficient to do so, because the uninformed employees would not be willing to make wage concessions in bad states. In the employee-owned firm, however, there is no such information asymmetry and hence no inefficient layoff.¹¹ Meanwhile, to overcome the moral hazard problem caused by unobservability of effort, firms monitor their employees and punish employees who are found shirking. We assume that monitoring results are not verifiable which implies impossibility of punishing workers contingent on monitoring. Thus, in capitalist firms, firing is the only feasible punishment and it cannot be distinguished from layoffs in a verifiable way. The indistinguishability between firing and layoff, in turn, makes the owner of the capitalist firm not able to commit not to layoff employees.

In the capitalist firm, inefficient layoffs reduce the expected payoff to hardworking employees and thus make it more difficult for the CF to induce effort from employees than the EOF, regardless of the size of the firms (Propositions 1-3).¹² This also leads to the following major

⁸Hart and Moore (1994) also argue that employee ownership reduces the inefficiency caused by market power.

⁹Weitzman and Kruse (1990) and Weitzman and Xu (1994) explored possible productivity gain from profit sharing or cooperative in the framework of repeated games, which assumes (implicitly) efforts to be observable and non-verifiable. Fitzroy and Kraft (1986) discussed incentive issues by assuming observable efforts and existence of peer-pressures among fellow workers who jointly own the shares of the firm.

¹⁰We will further discuss the difference between our theory and the one of Alchian and Demsetze (1972) in the conclusion section.

¹¹Several independent opinion surveys discovered that in the firms which are implementing profit sharing employees share significantly more information about the firm than employees who are in the firms which are not implementing profit sharing (Weitzman and Kruse, 1990).

¹²A recent nationwide survey in the US shows that about 20% of employees in the US constantly worry about the possibility of their being laid off (CNN report, July 29, 1995).

results: the CF has to rely more on the use of the stick – a higher monitoring intensity – than the EOF to induce higher efforts from workers (Proposition 4);¹³ the social welfare associated with the EOF is at least as high as that associated with the CF. Moreover, our comparative static results (Propositions 5-8) show that the advantages of the EOF over the CF will be larger if: (i) the reservation wage is low; (ii) the monitoring intensity is high; (iii) the productivity is more uncertain; or (iv) the disutility of exerting a high effort is high. Together with the existing theories explaining disadvantages of EOF, our theory shed some lights on the conditions of the existence of the EOF. Regarding mixed ownership, the intuition developed in our model applies to the ESOP and profit sharing.¹⁴

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 capitalist firm and the employee-owned firm respectively. Section 5 compares the two types of pure ownerships. Section 6 shows comparative statics. Finally, section 7 concludes the paper and discusses policy implications of our theory on privatization, particularly the voucher approach.

2 Productivity and Monitoring

In our model, the productivity of an individual worker is stochastically determined by his/her effort, e , which is unobservable. Specifically, we assume that there are two effort levels: e_H and e_L , where $e_H > e_L$. The corresponding disutilities are $d_H = d(e_H)$ and $d_L = d(e_L)$, respectively, where $d_H > d_L$. Given the effort level e , the productivity depends on the state of the world¹⁵ and is

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

where $\alpha \in (0, 1)$.¹⁶ The expected productivity is

$$E\{Y\} = q_2(2 - \alpha)e + q_1e + q_2\alpha e = e.$$

We assume that

$$e_H - d_H > e_L - d_L$$

so that e_H is the first-best effort level.

We assume 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 wage. 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. In such an environment, there is little incentive for the worker to exert any effort. To alleviate the shirking problem, firms employ managers to monitor workers randomly and

¹³In our model, the employee-owners of an EOF have to pay a price for the ownership; their expected payoff is higher than the payoff to workers in the CF not because they are given a free gift, but because there is no inefficient layoff in the EOF.

¹⁴Workers participating the ESOP enjoy partial control rights over the decisions of the firm by having their representatives sit in the board. Moreover, these workers enjoy some residual income of the firm by holding some equity shares of the firm (XXXX, Jones and Kato, 1995). In the case of non ESOP type of profit sharing, workers do not enjoy control rights over the firm but they enjoy some residual income of the firm by sharing the profits in the form of non-voting shares. The intuition of our model suggests that these institutional arrangements will improve incentives for the employees because they make the wage more flexible thus reduce the probability of layoff. For the sake of simplicity, our model deals only with the extreme case that workers do not know the productivity in the pure CF. In reality, as long as workers know less than the owner about the productivity of the firm, the intuitions developed by the model will still be valid. The benefit of cash bonus profit sharing scheme can be understood by the above argument.

¹⁵To concentrate on the issue of incentives, we assume constant returns to scale technology. Moreover, we assume that capital is perfect complement of the number of employees, i.e. not an independent variable, but is independent of the effort of the employees. These assumptions allow us to simplify our model without loss generality with respect to the issues which we are interested in.

¹⁶Both α and q could depend on e . The results won't change.

punish workers who are found shirking. Monitoring is assumed to be costly and imperfect. 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 constant. Assume that the probability of a worker being found shirking (exerting the lower effort e_L) when being monitored is $r(e)$, a function of the workers' effort level, e . Denote $r_H = r(e_H)$ and $r_L = r(e_L)$. We assume that $r_H = 0$, and $r_L \in (0, 1)$. That is, hard working employee is never found shirking but a shirking worker has a positive probability to be found working hard even when he is monitored; monitoring is imperfect. Given the widely accepted property that effort cannot be objectively measured, it is inevitable that monitoring of effort essentially involves subjective evaluation. Therefore, monitoring results are not verifiable. The non-verifiability of monitoring makes it impossible to write down contracts contingent on monitoring 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 (CF) and employee-managed firms (EOF).

3 Capitalist Firms

The objective of the CF is to maximize the expected profit of the firm by choosing the wage level, w , and the monitoring intensity, p .

We first discuss the case where the firm chooses to induce the high effort e_H . In this case, when the firm finds the worker to be shirking, the correct inference is that the worker has indeed shirked. Under Assumption 1, the punishment for a worker found shirking cannot be specified in a contract contingent on the monitoring result. There seem to be two possible punishments available to the firm: to reduce the wage of the worker (or demotion); or to fire the worker.¹⁷ However, without a wage contract contingent on the monitoring results (given the non contractible monitoring condition) the wage reduction will be abused by the firm (e.g. reduce wages of hardworking workers after their efforts have been exerted), thus is not acceptable by the workers *ex ante*. This leaves firing the worker the only feasible punishment.

At the same time, firing must be a credible threat, i.e. it must be subgame perfect. To simplify the exposition, we make the following assumption about the parameters of the model:

Assumption 2: The optimal wage for inducing the high effort, w_H , is higher than the highest possible productivity of the worker from the low effort; i.e. $w_H > (2 - \alpha)e_L$.

Under this assumption, it is subgame perfect for the firm to fire a worker when he is found shirking. Given a worker's effort level e , the probability that the worker is not fired under the monitoring intensity chosen by the firm, p , is $1 - pr(e)$.

In the CF, there is asymmetric information about the state of the world; only the firm knows it, but not the worker. This asymmetry in information is generated by a fundamental assumption that the right to audit is not contractible and hence is a residual right (Grossman and Hart 1986).¹⁸ Following Grossman and Hart (1986) and Hart and Moore (1990), we identify ownership with residual rights of control. In the capitalist firm, only the capitalist owners have the right to audit the managers and to fire the manager if they find the manager misrepresenting the performance of the firm. Such threats make the manager report the truth to the owners.¹⁹

¹⁷Other possible incentive schemes in the CF are ruled out by the assumptions of the model: the non-observability of individual performance makes the tournament competition impossible; the asymmetric information in the CF makes the bonus incentive scheme infeasible. Since workers do not know the productivity and the owner has incentives not to pay the bonus when workers do not know that they should get the bonus.

¹⁸When and what to audit under what condition may be too complicated to be fully specified in a contingent contract *ex ante*. Thus, the auditing right is a residual right of the owners. That is, only the owners have the right to decide when and what to audit under some unspecified contingencies, such as based on his/her own observation or managers' report.

¹⁹We 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 the time. However, it is impossible to conceal information from the owner without doing the same to the employees; the owner will get the information from some of the large number of employees. Therefore, the owner knows more than the employees do, which is sufficient for our result to hold.

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 announced by the firm.²⁰

With this asymmetry in information, the wage cannot be based on the state of the world; a worker will not be willing to make wage concession when the state of the world is bad. Therefore, only a fixed wage can be offered.²¹ A worker will be laid off when his productivity is lower than the fixed wage. For simplicity, we assume that the optimal wage offered by the firm is between αe and e .²² 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 and the common justification of which is that when the firm wants to layoff a worker, it can always make the job of the worker impossibly difficult so that an excuse can be found to fire the worker. Given the non-verifiability of the distinction, the firm cannot commit not to layoff workers. Otherwise, the firm has to commit not to fire anyone as well, which eliminates 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 as 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.

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 wage. The maximal profit the firm can expect is

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

Constraint (IR) implies that $w \geq \underline{w}$. The constraint (IC) can be rearranged as

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

²⁰For 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 with employees. Expecting this behavior, employees would not make wage concessions in real bad states.

²¹For simplicity and clarity, we do not consider complicated mechanisms that can be used to induce truth-telling from the firm to the employees. There is involuntary layoff or underemployment, either is inefficient, in all such mechanisms, as is the case in Grossman and Hart (1983). Therefore, our result would still hold even if we considered them. Furthermore, all such mechanisms are subject to renegotiation.

²²This 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.

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

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

The feasible region is the given in Figure 1.

Figure 1

Let's first solve the following optimization problem

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

From (IC), we can solve for w .

$$w = \underline{w} + \frac{\lambda}{pq}, \tag{1}$$

where

$$\lambda = \frac{d_H - d_L}{r_L}.$$

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

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

$$p^* = \begin{cases} p'' = \sqrt{\frac{\lambda}{c}} & \text{if } p'' \leq p' \text{ and } p'' \leq 1 \\ p' = \frac{\lambda}{d_H} & \text{if } p'' > p' \text{ and } p' < 1 \\ 1 & \text{otherwise} \end{cases}$$

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

$$\pi(e_H) = \begin{cases} (\beta e_H - \underline{w})q - 2\sqrt{\lambda c} & \text{if } p'' \leq p' \text{ and } p'' \leq 1 \\ (\beta e_H - \underline{w} - \frac{\lambda}{qp'})q - cp' & \text{if } p'' > p' \text{ and } p' < 1 \\ (\beta e_H - \underline{w} - \frac{\lambda}{q})q - c & \text{otherwise} \end{cases}$$

Proof: Substituting (1) into the profit function and rearranging, we have

$$\pi(p) = (\beta e_H - \underline{w})q - \frac{\lambda}{p} - cp. \tag{2}$$

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 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 as 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.

Here, for the monitoring intensity and the expected profit, there are three cases: (i) (IC) is the only binding constraint and $p < 1$; (ii) both (IC) and (IR) are binding; and (iii) (IC) is binding and $p = 1$.

Now we consider the case where the firm choose to induce the low effort level. When the firm does not want to induce the high effort, no monitoring is needed.²³ 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

$$\pi(e_L) = e_L - \underline{w} - d_L. \quad (3)$$

In the rest of this paper, for simplicity, we restrict our attention to the case where $p'' \leq p'$ and $p'' \leq 1$. This amounts to assuming that

$$\sqrt{\lambda c} \geq d_H. \quad (3.5)$$

The assumption holds when the monitoring cost, c , or the noise of monitoring, λ , is large, or d_H is small. In this case, only (IC) is binding in the firm's profit maximization problem when it chooses to induce the high effort. Under these restrictions,

$$\begin{aligned} \pi^c(e_H) &= (\beta e_H - \underline{w})q - 2\sqrt{\lambda c}, \quad (4) \\ \pi^c(e_L) &= e_L - \underline{w} - d_L. \end{aligned}$$

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

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

²³Suppose it is so easy to monitor a low effort that hiring specialized managers to do so is wasteful.

4 Employee Owned Firms

Now let's consider the EOF. Assume that the employees have all the bargaining power if they buy the firm either from the capitalist or the government (in the case of privatization). Therefore, the price they pay is π , the value of the firm to the capitalist. Also assume that the workers do not have money out of their pocket to make the purchase and have to borrow using the income of the firm as the collateral.²⁴ We make the following assumption about debt repayment:

Assumption 3: The worker's income after debt payment cannot be lower than his reservation wage, \underline{w} .

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

Similar to the case of the capitalist firm, the EOF hires managers to monitor workers to implement collectively chosen effort level and to overcome free-riding. Again, we first consider the case where the high effort is induced. For the sake of simplicity, again, we abstract away from the agency problem of the managers. If a worker is not found shirking, the correct inference is that he has worked hard and he will be paid $e_H - cp$. Otherwise, the correct inference is that he has indeed shirked and should be punished. By Assumption 3, the most severe, and thus the optimal, punishment is to pay the worker \underline{w} .²⁵

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

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

In the case of inducing the high effort, the EOF's program is to choose monitoring intensity p to maximize the surplus,

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

Lemma 2: When implementing a high effort level, the optimal monitoring intensity, p , and the expected surplus level, $\pi(e_H)$ will be the following:

$$\begin{aligned} p &= \frac{(e_H - \pi - \underline{w}) - \sqrt{(e_H - \pi - \underline{w})^2 - 4c\lambda}}{2c}; \\ \pi^l(e_H) &= \frac{(e_H - \pi - \underline{w})}{2} + \frac{\sqrt{(e_H - \pi - \underline{w})^2 - 4c\lambda}}{2} - d_H. \end{aligned} \quad (5)$$

Proof: 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 ²⁶

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

²⁴In 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.

²⁵It 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 hardworking fellows \underline{w} .

²⁶We assume that $\frac{(e_H - \pi - \underline{w}) - \sqrt{(e_H - \pi - \underline{w})^2 - 4c\lambda}}{2c} \leq 1$.

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.

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

$$\pi(e_L) = e_L - \pi - \underline{w} - d_L. \quad (6)$$

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

5 The Comparison of the CF and the EOF

Here, we follow the two assumptions made in the last section: (1) There is no liquidity constraint on the workers; they can always borrow to purchase a firm either from the investors or from the government (in the case of privatization); (2) The production function is the same in the two types of firms. Our first results on the comparison of the two types of firms show that the EOF is never worse than the CF in terms of the value of the firm, the effort level and the income of the employees.

Proposition 1: The EOF has non-negative surplus over the CF.

This proposition says that if workers compete with capitalists to buy a firm, they should never fail.

Proof: We consider two cases. In the first case, the CF chooses the low effort. Then $\pi = \pi^c(e_L)$. By (3) and (6), $\pi^l(e_L) = 0$ and the maximum surplus of the EOF is

$$\max\{\pi^l(e_H), \pi^l(e_L)\} \geq 0.$$

In the case where the CF chooses the high effort, by (4),

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

Therefore,

$$\begin{aligned} e_H - \underline{w} - \pi &= e_H - \underline{w} - (\beta e_H - \underline{w})q + 2\sqrt{\lambda c} \\ &= \alpha(1 - q)e_H - (1 - q)\underline{w} + 2\sqrt{\lambda c} \\ &\geq (1 - q)(\alpha e_H - \underline{w}) + 2\sqrt{\lambda c} \\ &\geq 2\sqrt{\lambda c}, \end{aligned}$$

Since $\pi^l(e_H)$ is an increasing function of $e_H - \underline{w} - \pi$, substituting the above result into equation (5), we get, by (3.5),

$$\pi^l(e_H) \geq \sqrt{\lambda c} - d_H \geq 0.$$

That is, the surplus of the EOF is non-negative.

Q.E.D.

Proposition 2: If the CF implements e_H , then so does the EOF.

This proposition says that the effort level in the EOF is never lower than that in the CF.

Proof: When the CF implements e_H , $\pi^c(e_H) \geq \pi^c(e_L)$ 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 (3) and (6),

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

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 3: The expected income of employees in the EOF is higher than that in the CF.

Proof: If the CF implements e_H , then by Proposition 2, so does the EOF. Employee's income in the EOF is $\pi^l(e_H) + d_H + \underline{w}$. The wage for the high effort in the CF is, $w(e_H) = \frac{\sqrt{\lambda c}}{q} + \underline{w}$. and the expected wage is $E\{w(e_H)\} = \sqrt{\lambda c} + \underline{w}$. By (3.5) and Proposition 1,

$$\pi^l(e_H) + d_H + \underline{w} \geq \sqrt{\lambda c} + \underline{w} = E\{w(e_H)\}.$$

If the CF implements e_L , then $\pi = e_L - \underline{w} - d_L$, $w = \underline{w} + d_L$, and the expected income of the employees is $\underline{w} + qd_L$.

In the EOF, if e_L is implemented, the expected income of the employees is

$$e_L - \pi = \underline{w} + d_L \geq \underline{w} + qd_L.$$

If e_L is implemented, the expected income of the employees is $\pi^l(e_H) + \underline{w} + d_H$, which is no less than $\underline{w} + d_H$ by Proposition 1. Therefore,

$$\pi^l(e_H) + \underline{w} + d_H > \underline{w} + qd_L.$$

Q.E.D.

The next result is about the comparison of monitoring intensity in the two types of firms.

Proposition 4: Under our assumptions, the EOF uses less intense monitoring than the CF when both types of firms implements the high effort.

Proof: When the CF implements the high effort, the monitoring intensity adopted by the CF is

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

In the proof of Proposition 1, we showed that, under the assumption of Proposition 4,

$$e_H - \underline{w} - \pi \geq 2\sqrt{\lambda c}.$$

Therefore, the monitoring intensity in the EOF is

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

Q.E.D.

The key reason behind this result is that there are inefficient layoffs in the CF due to information asymmetry and they reduce the payoff to hard work and thus make it necessary to adopt higher monitoring intensity to induce the high effort level. This is also the main reason why the workers find it worthwhile to purchase the CF and convert it to a EOF.

Empirical studies find that there are fewer managers and the managers are paid less in the EOF than in the CF. If we interpret managers as monitors and use the salary of the managers as an indicator of the monitors' quality, then the conclusion of Proposition 4 agrees with the empirical finding.

Corollary: Under our assumptions, 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, by Proposition 2, so does the EOF. In this case, the same effort is made by employees in the two types of firms but, by Proposition 4, the cost of monitoring is smaller in the EOF. Therefore, the EOF has higher social welfare.

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 on social welfare. It could do better by implementing the high effort.

Q.E.D.

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

One important feature of our theory is that workers of the EOF pay the value of the firm to the original owners. Another important feature is that our model include the case of large firms. In the existing literature, the argument for the advantage of the EOF depends on the assumption of small firms where each worker has some incentive to work hard because he gets a share of the return to his effort. When the size of the firm is large, such argument collapses.

6 Comparative Statics

In this section, we investigate how the advantages of EOF over the CF change with the reservation wage, the monitoring cost, the productivity uncertainty, and the disutility of the high effort, d_H . We find that our results fit empirical evidence very well. To concentrate on the more interesting case, we again discuss only on the case where both types of firms implement the high effort level. The advantages of EOF over the CF is measured by π^l .

Proposition 5: π^l is a decreasing function of the reservation wage, \underline{w} .²⁷

Proof: π^l is an increasing function of $e_H - \underline{w} - \pi$, which we showed in the proof of Proposition 1 to be

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

Therefore π^l is decreasing in \underline{w} .

Q.E.D.

The size of the reservation wage \underline{w} is closely related to firm-specific human capital. When the human capital of the workers is firm specific, its value outside of the firm is low thus the workers will earn less from jobs in other firms. Therefore, low reservation wage is related to the importance of firm-specific human capital. The conclusion of the above result can then be interpreted as: the more firm-specific is the human capital of the workers, the more efficient is employee ownership than capital ownership. This result agrees with the empirical fact that more EOFs are in the professional service sector (e.g. law firms, accounting firms, etc.), because firm-specific human capital is more important in the sector.

Proposition 6: π^l increases with monitoring cost λc .

²⁷Putterman and Skillman (1992) prove a similar result but in a very different way.

Proof: Similar to the proof of Proposition 5, 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 .

Q.E.D.

The intuition for the result is that the monitoring intensity required for implementing the high effort in the EOF is lower than that in the CF. Thus when monitoring cost is high, it affects the surplus/profit less in the EOF than in the CF. This result fits well with the fact that a lot of R&D firms are owned by the researchers in the firm. The complexity of R&D activities makes their monitoring very difficult thus particularly costly.

Proposition 7: The more uncertain is productivity, the more efficient is employee ownership than capitalist ownership.

Proof: The stability of the productivity is measured by q . π^c is increasing in q and π^l is decreasing in π^c . Therefore, π^l is decreasing in q .

Q.E.D.

This result implies that, everything else equal, employee ownership is more likely in sectors where profitability fluctuates more. The plywood industry and the construction industry are such examples. More detailed empirical work should be done here.

Proposition 8: The lower is the disutility of the high effort, d_H , the more efficient is employee ownership than capitalist ownership.

This result is easy to see from the expression of π^c and π^l . Its intuition is that the individual rationality constraint (IR) in the CF's maximization problem is not binding. The smaller is d_H , the larger is the slack and less valuable is the firm to the capitalist. We don't know of any empirical result that is related to this result and believe it should be examined empirically.

7 Conclusion

This paper contributes to the understanding of employee ownership by providing a model to show that the free rider problem does not render employee ownership ineffective as a means to motivate employees; employee ownership may be advantageous even for firms of large size. In fact, our results do not depend on the size of the firm. This is in sharp contrast to some economists have suggested (e.g. Alchian and Demsetz, 1972). The comparison between the two types of firms depend rather on parameters such as human capital specificity, productivity uncertainty, monitoring cost etc. Our results also provide directions for further empirical research on the EOF.

Some qualifications of our theory is in order. First, our theory concentrates on one important aspect of the firm: effort of the workers. There are some 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). It is also believed that collective decision making in the EOF is more difficult than managerial decision making in the CF (Hansmann, 1988, 1990). Combining these elements as the extra cost for the EOF, our theory could shed some lights on the conditions for the existence of the EOF in market economies.

Second, there is no risk in our model. There are some risks which lower the welfare of workers in the CF, such as risks related to layoff. However, there are other risks which lower the welfare of workers in the EOF, such as risks related to the variation of the income of workers, or non-diversified assets of workers. Adding risks into our model will make the model much messier without gaining more understanding.

Third, to keep our model manageable, we do not analyze the conflicts between owners and managers. For understanding large firms, where separation of ownership and control is prevalent,

it is important in the future work to analyze such conflicts explicitly. However, we want to point out that under the conditions of our model, owners and managers share the information of the firm. Thus owners of both types of firms can always put managers into incentive schemes to motivate them to work hard in monitoring workers. This implies that in the aspect of motivating managers, there is no difference between the CF and the EOF. This reasoning is different from that of Alchian and Demsetz (1972), which argues 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 is the ultimate residual claimant thus the well motivated ultimate monitor.

Finally, our model has an important implication on the approach of 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, to acquire it. We can modify the model slightly so that the workers pay a fixed price. Then, 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 is the price, the more efficient is the EOF. Because a lower price gives the workers a higher income and thus makes it less costly to induce effort. This feature justifies the approach of giving away vouchers to workers in privatization. This approach to privatization has been practiced in some Central and Eastern European countries and is an option to consider for the Chinese reform of state-owned enterprises.

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