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Ownership and Managerial Competition: Employee, Customer, or Outside Ownership

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Ownership and Managerial Competition:
Employee, Customer, or Outside Ownership[1]

(Preliminary. Comments Welcome)

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Abstract

It is widely accepted that only the protection of private property rights and competition by rival firms provide adequate incentives to perform for managers and employees. However, it is not entirely clear how ownership interacts with competition. This paper centres around the question of ownership of firms and managerial competition and how these affect managers and employees' incentives to invest in human capital.

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INTRODUCTION

There is a wide consensus nowadays that most economic activities are best undertaken in a market environment with private property. It is generally accepted that only the protection of private property rights and competition by rival firms provide adequate incentives to perform.[2]

This general belief has led to a worldwide wave of privatization. The striking success of some of the early privatization programs has also reinforced economists' beliefs in the overall virtues of the market system and private property.

Most proponents of privatization believe that "the market" and "private property" go hand in hand. but if for some reason production does not take place in privately owned firms it is still preferable to organize the allocation of goods and factors of production around some market system. Such a market system would work better than a centrally planned system but not as well as a market system organized around privately owned firms. This is. in a nutshell the consensus view of today.

However, it is not obvious a priori why private property is essential for the well functioning of markets, or how it matters. From a theoretical perspective at least. it is not clear that ownership matters at all when there is sufficient competition in the market. Another important consideration is that private ownership can take many different forms. A firm may be owned by dispersed outside shareholders. or by a single outside owner. It may be owned by employees. as in partnerships and producer coops. Or it may be owned by customers. as is the case of consumer coops. joint ventures. of some types of service companies. and of firms producing intermediate products. This diversity of arrangements suggests that the question may be not so much whether private ownership is essential than what type of ownership is adequate. customer. employee or outside ownership?

This paper provides a theoretical analysis of the interaction between managerial competition and ownership of firms taking the incomplete contracting perspective pioneered by Grossman. Hart. and Moore (see Grossman and Hart (1986). Hart and Moore (1990). and Hart (1995)). It asks who should own the firm: customers. employees or outside owners and how the efficiency of any of these ownership allocations depends on the extent of competition in managerial labor markets. While we are accustomed to thinking of

[2] However. we share the view that identification of privatization with competition is misleading (Hart. Shleifer and Vishny (1997))

firms as owned by third parties, employee-owned firms, or customer-owned firms are not uncommon.

We consider in turn three situations with increasing degrees of competition. In the first there is a single firm composed of only one employee: there is then no managerial competition and incentives for human capital acquisition can only be affected by allocating ownership of the firm to either an outside owner, the employee, or customer(s). In the second, there are two employees inside the firm competing to serve customer(s): this is a situation where employees compete in the firm's internal labor market. In the third situation, we consider two firms with two employees each, where competition takes place both internally and externally. One of the core questions we shall be concerned with is which form of ownership allocation maximizes the protection provided by competition of employees' human capital investment.

The remainder of the paper is organized as follows. Section 2 outlines the model. Section 3 considers ownership of firms in the absence of any competition. Here, the main result is that employee ownership or customer ownership is optimal whenever the firm's assets are sufficiently complementary with the human capital of the employee. With weak forms of complementarity, on the other hand, outside ownership may be optimal.

Section 4 allows for competition among employees inside the firm. This is a situation where the employees' ex-ante investment is sufficiently firm specific that they are effectively locked-in. Here the main result is that outside ownership is always dominated by either employee or customer ownership. Employee ownership dominates customer ownership when customer-owners are heterogeneous ex-post. However, if a firm is owned by the customers who like the product for sure, customer coop may dominate. Moreover, we distinguish partnerships from employee coops: when some employees are able to distinguished themselves as more productive than others, a partnership which restrict the ownership to those distinguished members (partners) may be optimal; or when all employees have an equal capability an employee coop may be optimal.

Section 5 allows for competition within and across firms. Our main result is that if employees are homogeneous and the firm's assets are sufficiently complementary with the human capital of the employee then ownership is irrelevant (provide, of course, that the managerial labor market works well). However, when employees are heterogeneous ex-post, ownership structure matters (partnership may dominate other ownership structures while employee coop may be the worst) even when there is no lock-in. Section 6 briefly considers the horizontal integration decision between firms. Finally, section 7 offers some preliminary concluding remarks.

THE MODEL

We consider a model with three types of agents: customers. employees and outside owners. For most of the paper we shall suppose that there is only one customer and one outside owner. but more than one potential employee. Only one employee is needed and with more than one employee available there is competition for the provision of the service between employees. To keep things simple we assume that all agents are risk-neutral and are primarily interested in maximizing income. The core transaction we focus on is a service provided by employee(s) for a customer. The value of the transaction may be enhanced if it is produced with the help of some (physical) asset. or on the premises of a firm. The main question we shall be concerned with is who should control the use of the asset or own the firm: employees. customers or outside owners? As in Grossman and Hart (1986) we shall suppose that only owners have residual rights of control over the asset or the firm. Before transacting employee(s) can invest in human capital. This investment enhances the value of the transaction and is non-contractible..

There are many possible real world examples that may correspond to this stripped down set-up: law firms. consulting firms. investment funds. professional schools. R&D ventures. medical firms. etc. In all these examples employees must undertake several years of training and undergo periodic retraining to be able to provide even basic services. Also. by the time they are transacting their training costs are sunk and generally contracts with customers are only written after training has been completed. For all these examples one observes a variety of different ownership arrangements. Some firms are owned by employees. others by customers or outside owners (see Hansmann (1996) for an overview of the different ownership allocations observed in practice).

More formally. in the first stage of our game employee(s) make a costly (unverifiable) human capital investment of k at a cost of $c(k)$. We shall assume without much loss of generality that $c(k) = k$. When this investment is completed. employee and customer enter a service transaction. The total value of the service is given by $v(k)$ if it takes place outside the firm. When. instead. it takes place inside the firm it is given by $V(k)$. We assume throughout this paper that :

$$V(k) > v(k) \text{ and } V'(k) > 0; v'(k) > 0; V'''(k) \leq 0; v''(k) \leq 0$$

A transaction in a firm creates more value either because the firm provides access to facilities which otherwise are not available or because the firm extends it's reputation to the transaction. As in Grossman and Hart (1986). we assume that *ex post* contracting

takes place under symmetric information and is efficient.

Thus, the timing of moves is as follows: (i) at date 0, firm ownership is determined; (ii) at date 1, employee(s) make human capital investments which generate uncertain values; (iii) at date 2, the uncertainty is resolved and the parties bargain over the price of the service; (iv) at date 3, the service is provided.

Obviously, a key question is how bargaining works in our model? A natural and often used bargaining solution for multilateral bargaining problems is the Shapley value[3]. This is the solution we shall adopt when there is no competition between employees. Unfortunately, however, the Shapley value does not adequately reflect the outcome of competition among employees. Therefore we consider an alternative bargaining solution based on the so called "outside option principle" (see Binmore, Rubinstein and Wolinsky, 1986) when we consider situations where two or more employees compete with each other[4].

To see why the Shapley value is not an entirely satisfactory solution consider the situation where two identical employees compete for a single customer. In such a situation competition à la Bertrand between the employees would lead to a surplus division where the customer gets the whole net surplus v. But the Shapley value in this case is $\frac{2}{3}v$ for the customer and $\frac{1}{6}v$ for the employees.

Given that we consider bargaining situations involving up to four or more parties (two or more employees, one customer and one outside owner) we cannot unfortunately use an "off the shelf" bargaining-with-outside-options-solution, since such a solution is simply not available in the bargaining literature. We are therefore led to specify very simple extensive form bargaining games which capture the logic of the outside option principle.

In all these games the weakest party (with no outside option) is assumed to make a take-it-or leave-it offer to the other parties. The other parties can accept or reject. If one of them rejects either the game ends or bargaining proceeds to another stage, where another party is selected to make a take-it-or-leave-it offer. We shall allow for at most two stages in all the bargaining games we consider.

While the rules of these bargaining games may appear somewhat arbitrary they have the virtue of keeping the analysis of bargaining as simple as possible. Moreover, the solution of these games capture in a simple way the logic behind the outside option principle: when the weakest party makes the take-it-or-leave-it-offer it can hold the other parties down to

[3]This is the bargaining solution adopted in Grossman and Hart (1986), Hart and Moore (1990) and Rajan and Zingales (1996) to mention just a few papers where this solution is adopted.

[4]A number of papers have considered multilateral bargaining solutions based on the outside option principle. See in particular Bolton and Whinston (1993), and de Meza and Lockwood (1996).

at most their outside options.

OPTIMAL OWNERSHIP ALLOCATION WITH NO COMPETITION

In this section we consider a situation with no competition between employees. The optimal ownership allocations obtained in this case will serve as useful benchmarks to understand the relation between competition and ownership analyzed in the next sections. Thus, we shall consider a model here with one employee one customer and possibly one outside owner and we shall ask which of them should own the asset or firm.

Before we address this question we shall consider what happens when the employee and customer decide to transact on their own without using the asset or premises of the firm. In this case the total ex post surplus from the transaction, $v(k)$, is split equally between the employee and the customer and the employee chooses k in stage 1 to maximize

$$\frac{v(k)}{2} - k. \tag{1}$$

and ends up underinvesting in human capital. Indeed, from a first-best perspective he should set k to maximize

$$v(k) - k.$$

Now, suppose that the employee uses the firm's asset(s) to serve the customer. He is then able to generate a total ex-post surplus of $V(k) > v(k)$. For convenience, we shall assume throughout this paper that $V(k) = f(v(k))$, with $f' \geq \underline{v}$ and $f'' \leq \underline{v}$. Here, f' is the marginal contribution of the firm assets to the marginal value of production. It can be taken to be a measure of to the complementarity between the firm's assets and the employee's investment in human capital. More precisely, when $f' > 1$ the firm's asset is complementary to the employee's investment in human capital and consequently increases the marginal value of the employee's investment: and when $f' < 1$, with the firm's assets the marginal value of the employee's investment will be reduced.

The first-best when production takes place on the firm's premises is for the employee to set k to maximize $V(k) - k$, and the first-best level of investment, k^* is given by:

$$V'(k^*) = f'v'(k^*) = 1.$$

Obviously, the employee's first-best incentives to invest in human capital are then increased if and only if $f' > 1$ around $\widehat{k}$, where $\widehat{k}$ solves $v'(\widehat{k}) = 1$.

What happens now in a second-best situation where human capital investment k is not contractible? We first look at the case where the firm is owned by a third party.

Outside Ownership

Ex-post it is always efficient to undertake production on the firm's premises, since then more value is created. Thus, under outside ownership of the firm, owner, employee and customer bargain over the surplus of production generated in the firm, $V(k)$. As we explained in the previous section, we take the Shapley value as the bargaining solution in this case with no competition between employees. This solution is as follows:

- the outside owner gets $\frac{V-v}{3}$
- the customer and employee each get $\frac{V-v}{3} + \frac{v}{2}$.

Thus, in stage 1 the employee now chooses k to maximize

$$\frac{V(k) - v(k)}{3} + \frac{v(k)}{2} - k \tag{2}$$

Hence, relative to the case where production is undertaken without the use of the firm's asset, the employee's marginal incentives to invest in human capital are increased if and only if,

$$\frac{V'(k^n) - v'(k^n)}{3} + \frac{v'(k^n)}{2} \geq \frac{v'(k^n)}{2},$$

where, k^n is the second-best optimal investment when production takes place outside the firm. Or,

$$V'(k^n) - v'(k^n) = (f' - 1) \cdot v'(k^n) \geq 0$$

Hence, the employee's incentives to invest in human capital are increased if and only if $f'(k^n) > 1$: that is, when the firm's asset is complementary with the employee's human capital.

The above result shows that even if access to production enhancing assets always adds value ex-post, the presence of these assets may be bad from an ex-ante perspective if it has a large negative impact on the employee's incentives to invest in human capital. Also, and more surprisingly, when the marginal contribution of the firm's asset is low, outside ownership may be preferable to other ownership structures, even though the outside owner makes no useful contribution to the provision of services. To see this, consider next the outcome under either employee or customer ownership.

Employee and customer ownership

When either the employee or the customer own the asset the ex-post bargaining solution is simply:

- $\frac{V}{2}$ for the employee.
- $\frac{V}{2}$ for the customer and.
- zero for the third party.

So that the employee's marginal incentives to invest are given by:

$$\frac{V'(k)}{2}. \tag{3}$$

Thus, under employee or customer ownership, the employee always under-invests regardless of the degree of complementarity between the firm's assets and the employee's human capital.

The optimal ownership allocation

Comparing the efficiency of outside ownership and employee/customer ownership, we can see that the employee in a firm under outside ownership invests more than an employee in a firm under employee/customer ownership if and only if $f' < 1$. Higher investment in human capital, however, does not necessarily translate into greater efficiency. There may be over investment in human capital! Indeed, under outside ownership the employee over-invests in human capital if and only if,

$$\frac{V'(k^*) - v'(k^*)}{3} + \frac{v'(k^*)}{2} = \frac{1}{6}[2f' + 1]v'(k^*) > f'v'(k^*)$$

or,

$$f' < \frac{1}{4}.$$

The reason why overinvestment may occur here is that investment in human capital strengthens the employee's bargaining position more than it adds to the total value of production in the firm. Such an outcome is possible whenever the marginal unit of investment adds more to the employee's outside option than to the value of production in the firm.

Comparing the employee's incentives for investment in human capital under the three regimes we can thus conclude that *employee or customer ownership is optimal* from an ex-ante perspective if and only if. $f' > 1$. In other words. employee and customer ownership is optimal whenever the complementarity between the firm's assets and the employee's human capital is high enough. When $f' < 1$, outside-ownership dominates in general. except when $f' \ll \frac{1}{4}$, in this case it is not clear whether under-investment under employee ownership or over-investment under outside ownership is more efficient.

To summarize. our analysis so far yields the following result:

Proposition 1 *When there is no competition at all.*

1. *employee or customer-ownership dominates outside-ownership whenever the firm asset's marginal contribution to the marginal value of production is high. that is,* $f' > 1$;

2. *whenever the firm's marginal contribution is low. (that is,* $\frac{1}{4} < f' < 1$*) outside-ownership dominates both other forms of ownership as long as* f' *is not too small; and*

3. *when the firm's marginal contribution is very low.* ($f' < \frac{1}{4}$) *the employee over-invests under outside-ownership. Then. depending on the extent of overinvestment either outside or employee/customer ownership may be optimal*

The basic intuition behind these results is straightforward. When $f' > 1$. an additional unit of investment adds more to the total value of production than to the bargaining position of the employee under outside ownership. As a result. the employee tends to underinvest when the firm is owned by a third party. The employee's incentives to invest can then be improved by allocating ownership either to the employee or the customer. Alternatively, when $f' < 1$. the employee's incentives to invest are enhanced under outside ownership. Introducing an outside owner then has similar effects to the introduction of a "budget-breaker" in Holmstrom's (1992) moral hazard in teams problem. It serves the purpose of providing better marginal incentives to invest. However. contrary to Holmstrom (1992) the introduction of an outside owner may result in excessively strong incentives to invest for the employee.

These results are also related to similar observations made recently by Rajan and Zingales (1996) and de Meza and Lockwood (1996). Just as in de Meza and Lockwood (1996) removing ownership of the asset from the employee may induce him to invest more by providing him with better marginal incentives to invest. The effect works through the

bargaining position of the employee. as in their model. although here the bargaining solution is not based on the outside option principle. Another important difference with their analysis is that here the removal of ownership may be inefficient even though it increases investment incentives when. as a result. the employee has incentives to overinvest. The mechanism behind the result of Rajan and Zingales (1996) is different from ours. In their model ex-ante investment may reduce the value of the asset. By removing ownership of the asset the negative effect on investment incentives of the reduction in ex-post asset value is limited. so that investment incentives may be increased.

COMPETITION IN INTERNAL LABOR MARKETS

In this section we consider the case of perfect lock-in where employees' human-capital is perfectly firm specific. Then the only possible form of competition between employees is within the firm. The most stripped down model of this case is a single firm model with two employees competing for one or several clients of the firm. If there is a single client there will be excess supply of services by employees. but if there are $n \geq 3$ clients then there is excess demand. It turns out that the optimal ownership allocation depends on the strength of demand. We shall first consider the simplest case where there is a single customer. We then proceed to show how some of our conclusions are reversed in the other polar case where the number of clients is large relative to the number of employees.

We denote by V^i the value of production in the firm with employee $i = 1, 2$. and by V the value of production when both employees participate in production. Also. we denote by k_i the investment in human capital of employee $i = 1, 2$.

We distinguish between four possible ownership structures : i) outside ownership: ii) employee cooperative: iii) partnership and iv) customer cooperative.

For reasons of tractability we shall restrict attention to the following functional forms for v^1 and v^2:

$$\left\{ \begin{array}{l} v^1(k_1) = \lambda \log(1 + k_1) \text{ and } v^2(k_2) = \underline{v} \text{ with probability } \alpha_1 \\ v^1(k_1) = \underline{v} \text{ and } v^2(k_2) = \lambda \log(1 + k_2) \text{ with probability } \alpha_2 \end{array} \right\}$$

with $\lambda > 1$, $\alpha_i \in (0, 1)$ and $\alpha_1 + \alpha_2 = 1$. Here. the difference $|\alpha_1 - \alpha_2|$ is a measure of heterogeneity between the two employees. As before we set $V^1 = f(v^1(k_1))$ and $V^2 = f(v^2(k_2))$. where. f is the same increasing function as in section 3. When there is only one customer we shall also assume that $V(k_1, k_2) = \max\{V^1(k_1), V^2(k_2)\}$. This formalization captures the idea that although employees may be similar ex ante their ex-post realized human capital value will always be different. Moreover. with only one customer only

the better employee is necessary for production. This assumption implies that ex-post competition between employees takes an extreme form: ex post only one employee is valuable[5].

With probability α_1 employee 1 is the "good" employee and contributes a total value of $V^1 = f(\lambda \log(1+k))$, and employee 2 is the "bad" employee with a total value of $V^2 = f(\underline{v}) = \underline{V}$. Vice-versa, with probability α_2, $V^1 = f(\underline{v}) = \underline{V}$ and $V^2 = f(\lambda \log(1+k))$. We take λ to be large enough that $\lambda \log(1+k) > \underline{v}$ for all relevant choices of k. Also, for convenience we shall use the notation $\bar{V}$ for the higher value of the two employees and $\underline{V}$ for the lower value.

Outside Ownership

Under outside ownership negotiations now involve four parties: the two employees, the owner and the client. As before, the employees can in principle offer their services without using the firm's asset. The total surplus of this exchange would be lower but the owner would then be cut out of the deal. This possibility provides the employees with an outside option in their negotiations with the owner. Similarly, the owner, one of the employees and the customer can freeze out the other employee. The only party that cannot be excluded is the customer.

To model this potentially complicated negotiation game we proceed as follows. As explained in section II, we capture the outside options principle in this multilateral bargaining game with competition by specifying a simple two-stage game: in the first stage, the owner makes a take-it-or-leave-it offer to the two employees and the customer. If the offer is accepted, the game ends. If the offer is rejected, the game goes to a second and final stage, where the two employees make take-it-or-leave-it offers simultaneously to the customer. If the customer accepts one of the offers, the game ends. If the customer rejects all the offers, every player gets a zero payoff and the game ends.

Without loss of generality, suppose that employee E_1 is ex-post more capable than employee E_2. Then, we use backward induction and start from the second stage of the bargaining game to find the solution of the overall bargaining game.

In the second stage, both employees compete for the customer à la Bertrand and the equilibrium offers are $\underline{v}$. At that offer, the customer picks the better employee. Therefore,

[5] In addition, an implicit assumption in these functional forms is that human capital investment only adds value for the employee who is best ex post. This assumption is inessential when there is only one customer. It will be relaxed when we consider the case of multiple customers.

E_1 gets $\overline{v} - \underline{v}$ and the customer $\underline{v}$, while E_2 gets zero. These equilibrium payoffs are their outside options in the first round of bargaining with the owner. Therefore the outside owner will make an offer of $\overline{v} - \underline{v}$ to E_1 and $\underline{v}$ to the customer and keeps the residual $\bar{V} - \bar{v}$. Thus, under outside ownership the bargaining solution in our simple extensive form bargaining game is given by:

Lemma 1 *Under the outside ownership, the bargaining solution is given by:*

Agent:	*employee* E_1	*employee* E_2	*outside owner* O	*customer* C
share:	$\overline{v} - \underline{v}$	0	$\overline{V} - \overline{v}$	$\underline{v}$.

While this extensive form game may appear to be somewhat ad hoc, it does capture in a simple and stark way the effects of competition between employees. It also captures in an intuitive way the outside options principle. It is possible to allow for richer (finite) bargaining games with alternating offers and counter-offers which give unique bargaining solutions identical to the one above (see e.g. Bolton and Whinston (1993)). These bargaining games may appear to be more satisfactory and general but they are no less ad hoc than the one considered here.

Given that $E_1$and E_2 each has respectively an α_1 and α_2 chance of being the better employee ex post, their ex-ante expected gross payoffs are $\alpha_i(\overline{v} - \underline{v})$ for $i = 1, 2$ under outside ownership. Thus, employee E_i $(i = 1, 2)$ chooses his initial investment in human capital k_i given a level k_j chosen by employee E_j to maximize:

$$\max_{k_i \geq 0} \{\alpha_i(\lambda \log(1 + k_i) - \underline{v}) - k_i\} \tag{4}$$

We thus obtain the following result:

Lemma 2 *For λ large enough, ex-ante (symmetric) equilibrium investment levels under outside ownership are:*

$$k_i^O = \alpha_i \lambda - 1, \; i = 1, 2.$$

Since we are considering a model where ex-post values of individual investments are stochastic we obtain a very simple solution for the optimal choice of human capital investments for the two employees. In particular, we need not consider mixed strategy equilibria in the investment stage, as in de Meza and Lockwood (1997) and Rajan and Zingales (1997).

Customer Cooperative

When the firm is owned by the customer the negotiation game reduces to a simple trilateral bargaining game between the two employees and the owner-customer. As under outside ownership we model bargaining as a two stage game where. in the first stage the customer-owner offers a take-it-or-leave-it offer to the two employees. If the offer is accepted. the game ends. If the offer is rejected. the two employees can make take-it-or-leave-it offers simultaneously to the customer-owner. As before. if the offer is rejected every one gets a zero payoff and the game ends. Again proceeding by backward induction. and assuming again that E_1 has a higher ex-post value the equilibrium payoffs in the second stage are given by:

Agent:	employee E_1	employee E_2	outside owner O	customer C
share:	$\overline{V} - \underline{V}$	0	0	$\underline{V}$

The difference with the previous game is that now the customer can always secure the use of the asset since he owns it. We highlight this result in the following lemma:

Lemma 3 *The bargaining solution under customer cooperative is*

Agent:	*employee* E_1	*employee* E_2	*outside owner* O	*customer* C
share:	$\overline{V} - \underline{V}$	0	0	$\underline{V}$.

Given that each employee E_i has an α_i chance of being the better employee ex post, employee E_i's ex-ante expected gross payoff is : $\alpha_i \left(\overline{V} - \underline{V}\right)$. and therefore each employee chooses his investment level to maximize

$$\max_{k_i \geq 0} \{\alpha_i (f(\lambda \log(1 + k_i)) - f(\underline{v})) - k_i\}. \tag{5}$$

We. thus. obtain:

Lemma 4 *The (symmetric) equilibrium investment levels under the customer cooperative are:*

$$k_i^C = \alpha_i \lambda f' - 1$$

It is easy to see here that the (Nash-equilibrium) investment incentives of each employee coincide with the socially optimal investment incentives. Indeed. if the social objective is to maximize total expected value. then the planner's ex-ante investment problem is:

$$\max_{k_1 \geq 0, k_2 \geq 0} \{[\alpha_1 f(\lambda \log(1 + k_1)) - k_1] + [\alpha_2 f(\lambda \log(1 + k_2)) - k_2]\}$$

and we have obviously.

Lemma 5 *The First-best choice of investment levels is:*

$$k_i^* = \alpha_i \lambda f' - 1.$$

Note that we must have $f' > \frac{1}{\alpha\lambda}$ and $\alpha = \min\{\alpha_1, \alpha_2\}$. here to guarantee that the first best investment is non-negative. Again. this requires λ to be large enough.

Employee Cooperative

When the firm is owned jointly by employees. decisions on the use of the firm's assets must be agreed on by both employees[6]. The point is that with only two employees majority voting does not make much sense. This is why we assume that under an employee cooperative unanimous agreement must be obtained[7]. The main effect of this decision rule, as we shall see, is to dull competition among employees relative to a customer cooperative.

As before. we consider a two stage bargaining game: If there is no agreement on the use of the school's assets then bargaining proceeds to a second stage where employees compete to provide their services without the school's asset. In this stage the equilibrium payoffs are such that the customer gets $\underline{v}$ and the better employee gets $\overline{v} - \underline{v}$. Again. these payoffs are the outside options available to the customer and the better employee in the first round of bargaining. Just as under outside ownership. the owner(s) of the asset can thus get at most $\overline{V} - \overline{v}$ in the first round of bargaining. Since the asset is jointly owned by both employees they will negotiate to split this payoff in half. Therefore. the bad employee gets $\frac{1}{2}\left(\bar{V} - \bar{v}\right)$. and the good employee gets $\frac{1}{2}\left(\bar{V} - \bar{v}\right) + (\bar{v} - \underline{v}) = \frac{1}{2}\left(\bar{V} + \bar{v}\right) - \underline{v}$. Thus. the bargaining solution under employee cooperative (when E_1 has the higher ex-post value) is given by:

Lemma 6 *The bargaining solution under employee cooperative is:*

Agent:	*employee* E_1	*employee* E_2	*outside owner* O	*customer* C
share:	$\frac{1}{2}\left(\bar{V} + \bar{v}\right) - \underline{v}$	$\frac{1}{2}(\overline{V} - \bar{v})$	0	$\bar{v}$

Each employee E_i has an α_i chance of being a good employee. If the employee is bad ex post he will simply get a share of the surplus as a co-owner. but his human capital investment has no value. Therefore. each employee's ex-ante program is:

$$\max_{k_i \geq 0} \left\{ \alpha_i \left[\frac{1}{2} \left(f\left(\lambda \log(1 + k_i)\right) + \lambda \log(1 + k_i) \right) - \underline{v} \right] - k_i \right\} \tag{6}$$

[6] An alternative formulation which yields the same results is that one employee is picked at random to decide on the use of the firm's asset.

[7] If we extend our model to three or more employees. then decisions could be taken by majority voting. Our results would not be changed qualitatively in this extension.

Hence, we obtain the following result.

Lemma 7 *Under employee coop, the equilibrium investment levels are:*

$$k_i^{EC} = \max\{0, \frac{\alpha_i \lambda}{2}(f' + 1) - 1\}$$

Partnership

Under a partnership decision rights concerning the use of the firm's assets are allocated to only one employee, the partner[5]. That is, unanimity among all employees is no longer required to take a decision. This regime allows for a stronger form of competition to take place. When the partner is better than the junior employee he improves his bargaining position through his outside option. But when he is worse, he simply acts like an outside owner. We suppose again, without loss of generality, that E_1 is the good employee. When he is the owner (that is, when the owner is the good employee ex post) then the bargaining solution is given by:

Agent:	employee E_1	employee E_2	outside owner O	customer C
share:	$\overline{V} - \underline{v}$	0	0	$\underline{v}$

Indeed, in that case the problem reduces to a simple bilateral bargaining game with an outside option for the customer (which is to get the service from the bad employee outside the firm's premises). If, however, the owner is the bad employee ex post (that is here, if employee E_2 is the owner) then the bargaining solution is similar to that under outside ownership (with employee E_2 acting like an outside owner) and is given by:

Agent:	employee E_1	employee E_2	outside owner O	customer$C$
share:	$\overline{v} - \underline{V}$	$\overline{V} - \overline{v}$	0	$\underline{V}$

Therefore, if employee E_1 is the owner his ex-ante expected gross payoff is given by:

$$\alpha_1(\overline{V}(k_1) - \underline{v}(k_2)) + \alpha_2(\overline{V}(k_2) - \overline{v}(k_2)).$$

And employee E_2 's ex-ante expected payoff is $\alpha_2(\overline{v}(k_2) - \underline{V}(k_1))$.

Hence, E_1 and E_2 choose their human capital investments to solve respectively:

$$\max_{k_1 \geq 0}\{\alpha_1 (f(\lambda \log(1 + k_1) - \underline{v}) + \alpha_2 (f(\lambda \log(1 + k_2)) - \lambda \log(1 + k_2)) - k_1\} \qquad (7)$$

[5] With two employees this hardly looks like a partnership. Although this case looks artificial with two employees it should be clear that it corresponds to a more general situation where only the most able employees are promoted to the rank of partner and are thus given control rights.

and.

$$\max_{k_2 \geq 0} \{\alpha_2(\lambda \log(1+k_2) - \underline{v}) - k_2\} \tag{8}$$

We thus obtain the following hybrid solution for the equilibrium investment levels in human capital under a partnership (here E_1−ownership):

Lemma 8 *The equilibrium investment levels under the E_1−partnership are:*

$$k_1^{E_1} = \alpha_1 \lambda f' - 1, \text{ for the owner employee } E_1\text{: and}$$
$$k_2^{E_1} = \alpha_2 \lambda - 1, \text{ for the non-owner employee } E_2.$$

Remark 1 *Note that the incentives for the non-owner employee are the same as under outside ownership and that the partner-employee has socially optimal incentives to invest when $f' > 1$ (a similar result as that in the no competition case).*

Remark 2 *Here, the two employees are perfect substitutes ex-ante. If the two employees were perfect complements. then a partnership is the same as an employee-coop.*

Comparing Ownership Allocations

Comparing the equilibrium investment levels under different ownership structures. using the previous results summarized in the Lemma above. we obtain the following ranking of ownership structures under pure internal competition between employees.

Proposition 2 *:When there is competition between employees inside the firm and outside options bind, then:*

1. *the customer-coop achieves the first best:*
2. *When $f' > 1$ all other ownership structures give rise to underinvestment:*
3. *When $f' < 1$ all other ownership structures give rise to overinvestment;*
4. *If $|\alpha_i - \frac{1}{2}| = 0$ (employees are ex-ante homogeneous) the ownership structures ranked in the extent of human capital investment are as follows: employee coop is the second-best ownership allocation: it dominates the partnership . which in turn dominates outside ownership:*
5. *If $|\alpha_i - \frac{1}{2}| \gg 0$ (employees are ex-ante heterogeneous), then the partnership is the second-best ownership allocation: it dominates the employee coop. which in turn dominates outside ownership*

These results can be seen immediately by simply comparing the equilibrium investment levels under the different ownership structures. There are some subtleties in the comparison between the employee cooperative and the partnership. When both employees are sufficiently similar ex-ante . i.e.. $\alpha \approx \frac{1}{2}$. then the average employee's investment level is similar under both ownership structures. However. the variance of each employee's investment level is higher under the partnership. Since the production function is strictly concave the joint-employee ownership structure which has a lower variance is better. However. when employees are sufficiently different ex-ante. i.e.. $|\alpha - \frac{1}{2}| \gg 0$. the partnership may dominate the employee coop. Since allocating the ownership to the better employee will provide more incentives for the better employee than the employee coop.

An important difference with the case of no competition is that now outside ownership is always the worst ownership allocation. It either gives rise to the worst underinvestment or to the worst overinvestment. Thus. under internal competition between employees, third party ownership is always dominated by other forms of ownership. The striking result that the customer cooperative achieves the first best depends critically on a condition that the customers are homogeneous that they all like the product of the firm. We will discuss the case where this condition is relaxed in next subsection.

Moreover, another important implication of our theory is that the optimality of ownership structure may depend also on the job requirement. i.e. the qualification of the employees. If the qualification requirement is low such that if people are about the same in their talents for fulfilling the tasks. then allocating ownership to all the employees is the second best. This result may shed some lights on many of the observations in the literature. For example. in plywood cooperatives. worker-owners are semi-skilled and commonly rotate over time through the various jobs; managers are generally not members of the cooperative, but rather hired as salaried employee (Greenberg. 1984). Similarly. many car rental firms are owned by drivers jointly (Hansmann. 1996).

If the qualifications required in a firm are more related to people's talent which is no easy to identify ex-ante, that is employees are heterogeneous in qualifications: moreover, an employee's performance in the past may signal that he/she is more likely to perform well in the future. then allocating ownership to those employees who performed well in the past is the second best. This may explain why partnership is the dominant ownership in the service professions. such as law. accounting. investment banking. consulting. advertising. architecture. engineering. and medicine (Hansmann. 1996. pp.66-69). Here. partners are the employees who have performed well in the past. Take example of law firms. the partners in a law firm are more qualified lawyers with higher skill and productivity. and

less qualified lawyers are kept as permanent associates (Hansmann. 1996. p.91, 94 and n.9). United Airlines is owned by pilots and mechanists who are skilled but minorities of the employees (Hansmann, 1996. pp.117-118).

Customer Ownership when Customers Are Heterogeneous (sketch)

Consider now the situation where the customers are not homogeneous. Specifically. we assume that they are ex-post different on their value on the product. although ex-ante they have the same probability in their valuations on the product. We now suppose that one client ex-post do not want the product. i.e. the ex-post value of the product is zero; and the ex-post value of the product of another client is v if it is produced outside of the firm. or V, if it is produced within the firm. Ex-ante the two clients are the samc. that they both have $\frac{1}{2}$ probability to like the product or not to like the product ex-post. It is easy to show that the ex post heterogeneity of customers has no impact on the efficiency of other ownership structures except for customer ownership itself.

When a firm is owned by the two customers jointly (when the firm is owned by only one of the customers the result will be the same as the joint case), the expected value of the product for each customer owner is $\frac{V}{2}$. Thus. the bargaining solution is,

Agent:	employee E_1	employee E_2	outside owner O	customer C
share:	$\frac{1}{2}(\overline{V}-\underline{V})$	0	0	$\frac{V}{2}$

Therefore. each employee E_i's ex-ante expected gross payoff is : $\frac{\alpha_i}{2}(\overline{V}-\underline{V})$. and each employee chooses his investment level to maximize

$$\max_{k_i\geq 0}\{\frac{\alpha_i}{2}(f(\lambda\log(1+k_i))-f(\underline{v}))-k_i\}. \tag{9}$$

If the two customers are not the same ex-ante that with a probability of p customer C^1 will like the product and with a probability of $1-p$ customer C^2 will like the product. and if C^1 owns the firm, then the result will be similar except replacing $\frac{\alpha_i}{2}$ by $\alpha_i p$. We, thus. obtain:

Lemma 9 *If the owner-customer has a probability p to like the product ex-post. the equilibrium investment levels under the C^1 cooperative is:*

$$k_i^{C^1}=\alpha_i p\lambda f'-1$$

Therefore. it is obvious that if ex-ante it is known which customer likes the product ex-post and let that customer owns the firm. then customer coop achieves the fist best.

i.e..

$$k_i^C = \alpha_i \lambda f' - 1$$

This result sheds some light on the existing customer coops that their members (owners) like the product which the firm is producing homogeneously (e.g.. Hansmann. 1996).

Comparing Ownership Allocations.—

Comparing the equilibrium investment levels under different ownership structures. using the previous results summarized in the Lemma above. we obtain the following ranking of ownership structures under pure internal competition between employees.

Proposition 3 *:When there are two customers who are ex-ante the same but ex-post only one of them likes the product. the efficiency ranking of other ownership structures will not be changed from the case of homogeneous customers: however,*

1. *if ex-ante the customers cannot be differentiated on their preferences. customer ownership is dominated by other ownership structures;*
2. *if ex-ante the customers who likes the product owns the firm, then customer ownership achieves the first best.*

If we interpret a state ownership as a state-wide customer-ownership. then the first part of the above proposition tells us that the lack of interests of some of the owners on the products may make the publicly shared ownership inefficient. Moreover. on the other hand. our model also sheds new lights on existing customer coops where owners are a group of customers who demand the products. For example, the Associated Press has long been a coop owned by its customers — thousands of newspapers and broadcasting stations (Hansmann. 1996. p.158): retailer owned whole sale coops accounted for 80% of the US hardware market (Hansmann. 1996. p.157): MasterCard and Visa are coops owned by hundreds of local banks (Hansmann. 1996. p.158): Allied Van Lines was a coop owned by hundreds of moving companies (Hansmann. 1996. p.158): Finally. 43% of fertilizer: 38% of petrel: 30% of chemicals in US farms were supplied by farm supply coops (Hansmann. 1996. p.149).

It will be interesting to compare our results with some of the most recent theoretical works. In Hart and Moore (1998). a coop is optimal when members are homogeneous in preference. In Hart. Shleifer. and Vishny (1996). the trade-off between public ownership vs. private ownership is between non-contractible quality improvement and cost saving incentives..

Our results have far reaching implications for several of the applications of our model that we have in mind. As will become clear this general result can be extended under certain conditions to situations where employees compete both in internal and external labor markets.

INTERNAL AND EXTERNAL LABOR MARKETS

In the previous section we considered only competition between employees within a single firm. This is the only possible form of competition if employees' investments in human capital are entirely firm-specific, or if employees are entirely locked-in their firm for other reasons. In practice there is always some form of lock-in of employees. However, despite the likely presence of some lock-in it is not always appropriate to assume that lock-in is total. Indeed, in some labour markets competition between employees across firms can be more important than competition within a single firm. Therefore, we extend the model in this section to allow for both competition within and between firms. As a first step we shall consider the polar case where there is no lock-in of employees at all and compare our results to the previous polar case with total lock-in.

We consider the simplest possible extension with only two firms and two employees in each firm. We shall make the obvious adaptations from the previous setting to introduce competition for employees between firms.

We denote the two firms by m_1 and m_2; the two employees in each firm by E_{11}, E_{12} and E_{21}, E_{22}; and the two customers by C_1 and C_2. Each firm can serve only one customer, so that there is no competition between firms in the product market. Customers are identical and firms have identical assets. That is, for any of the four employees we have $V_1(k_{ij}) = V_2(k_{ij})$.

As before, all employees are identical ex ante. In period 1 they invest in human capital and the values of their investments are again random. We consider a similar stochastic structure as before, where ex post one employee is more valuable than the others and each employee is equally likely ex ante to become the better employee ex post (at equal investment levels): each employee now has a $\frac{1}{4}$ probability of being a good employee. That is, by investing k_i in human capital employee i gets an ex-post value of $v(k_i) = \begin{cases} \underline{v}, & \text{with probability } \frac{3}{4} \\ \lambda \log(1 + k_i), & \text{with probability } \frac{1}{4}. \end{cases}$

Again, we assume that $V(k_1, k_2) = \max\{V^1(k_1), V^2(k_2)\}$. That is, the best employee determines the value of the firm's product. Since there is only one good employee ex

post. there will be competition between firms to attract that employee. Each firm now attempts to attract the better employee so as to offer a better product to its customer.

We shall again consider in turn different ownership structures. The main new difficulty is to characterize the bargaining solution in each firm when there is competition between firms for the best employee. As it turns out. the bargaining games under each ownership structure can be straightforwardly adapted from the corresponding ones in the previous section. As one would expect. the main effect of competition between firms for the best employee is to strengthen the bargaining position of the best employee and consequently to widen the pay differential between good and bad employees.

Outside ownership

Consider first the situation where each firm is owned by an outside owner. The natural adaptation of the bargaining game under outside ownership considered before is to let each owner make a take-it-or-leave-it offer to their respective customers and to each employee in the first stage. Employees and customers can then accept one of the offers or reject all of them. If a firm has an offer accepted by it's customer and by at least one employee the game ends for that firm. If the firm's offer is rejected by either the customer or by all the employees then the game moves to a second stage (for that firm) where services can only be provided outside the firm's premises. In this stage the owner of the firm is frozen out and the employees make take-it-or-leave-it offers to the remaining customer(s). The customer(s) then accept(s) or reject(s) the offer and the game ends.

As before. we can solve for the bargaining solution by backward induction:

- Suppose that E_{11} is the good employee ex post. and that both firms end up in stage two of the bargaining game. Then Bertrand competition between employees results in the following equilibrium payoffs: employee E_{11} gets $\bar{v} - \underline{v}$, each customer C_i gets $\underline{v}$, and the other employees E_{ij} get 0.

- If only one firm ends up in stage two then it is easy to see that equilibrium payoffs are the same.

- These payoffs serve as outside options for the customers and employees in stage one. Given that there is no competition between firms for customers and bad employees. each firm can hold the customer and bad employee(s) down to their outside options as before. But. Bertrand competition for the good employee may result in a higher payoff for the employee E_{11}. Indeed. when $f' \geq 1$ employee E_{11} then gets $\bar{V} - \underline{V}$

and the other parties obtain respectively, 0 for employees E_{ij}, $\underline{v}$ for each customer and $\underline{V} - \underline{v}$ for each owner.

Thus, when $f' \geq 1$ the bargaining solution under outside ownership is given by:

Agent:	employee E_{11}	employee E_{ij}	outside owner O_i	customer C_i
share:	$\overline{V} - \underline{V}$	0	$\underline{V} - \underline{v}$	$\underline{v}$

- When $f' < 1$, on the other hand, $\overline{V} - \underline{V} < \overline{v} - \underline{v}$, so that the bargaining solution is determined entirely by the outside options in stage 2 and is given by:

Agent:	employee E_{11}	employee E_{ij}	outside owner O_i	customer C_i
share:	$\overline{v} - \underline{v}$	0	$\overline{V} - \overline{v}$	$\underline{v}$

These payoffs then translate into the following ex-ante investment choices for the employees. When $f' \geq 1$ they choose their investment in human capital k_i to maximize:

$$\max_{k_i \geq 0} \{\frac{1}{4}[f(\lambda \log(1 + k_i)) - f(\underline{v})] - k_i\} \tag{10}$$

and when $f' < 1$ they choose k_i to maximize:

$$\max_{k_i \geq 0} \{\frac{1}{4}[\lambda \log(1 + k_i) - \underline{v}] - k_i\} \tag{11}$$

We thus obtain the following solution for the investment choices under outside ownership.

Lemma 10 *The equilibrium human capital investment levels under outside ownership are given by:*

$$\max\{0, k_{ij}^O\}$$

where,

$$k_{ij}^O = \begin{cases} \frac{\lambda}{4} f' - 1, & \text{if } f' \geq 1 \\ \frac{\lambda}{4} - 1, & \text{otherwise} \end{cases}$$

It is interesting to see competition between firms at work here. When $f' \geq 1$ perfect competition gives employees the correct marginal incentives to invest ex ante. But when $f' < 1$, employees will over-invest.

Customer Cooperative

Consider now the case where each customer is also the owner of a firm (or has full control over the firm's assets). The same natural adaptation of the bargaining game

under outside ownership applies here: each customer-owner makes a take-it-or-leave-it offer to each employee in the first stage. Employees can then accept one of the offers or reject all of them. If a firm has an offer accepted by at least one employee the game ends for that firm. If the firm's offer is rejected by all the employees then the game moves to a second stage (for that firm) where the employees make take-it-or-leave-it offers to the remaining customer(s). The customer(s) then accept(s) or reject(s) the offer and the game ends. Again solving by backward induction one obtains the bargaining solution under customer cooperative:

- Bertrand competition between employees in the second stage of the bargaining game results in the following equilibrium payoffs: employee E_{11} gets $\overline{V}-\underline{V}$, each customer C_i gets $\underline{V}$, and the other employees E_{ij} get 0. It is easy to see that equilibrium payoffs are the same whether one or two customers end up in stage 2.

- These payoffs serve as outside options for the customers and employees in stage one. And the bargaining solution under customer cooperative is then given by:

Agent:	employee E_{11}	employee E_{ij}	outside owner O_i	customer C_i
share:	$\overline{V}-\underline{V}$	0	0	$\underline{V}$

As one might have expected, under customer cooperative competition between firms for good employees has no effect on the bargaining outcome. Under this ownership structure competition between employees inside a firm is maximized, and since both firms are identical competition across firms does not add any additional competitive pressure.

Each employee here chooses his initial investment in human capital k_i to maximize:

$$\max_{k_i \geq 0}\{\frac{1}{4}[f(\lambda \log(1+k_i)) - f(\log(1+k_j))] - k_i\} \tag{12}$$

so that equilibrium investment levels are given by:

Lemma 11 *The equilibrium human capital investment levels under customer cooperative are given by:*

$$k_{ij}^{C} = \frac{\lambda}{4} f' - 1.$$

Note that here the solution is the same whether $f' > 1$ or $f' \leq 1$. As before, the socially efficient outcome is achieved under this ownership structure.

Employee Ownership

Finally, consider the situation where each firm is jointly owned by two employees. The adaptation of the bargaining game under employee ownership we consider is to let each pair of employees first agree on a take-it-or-leave-it offer to their respective customers, to themselves as potential employees of the firm, and to the other two employees. As before, we assume that employees divide equally the surplus they can get as owners. Once the firms' offers are determined the game proceeds as under outside ownership. That is, employees and customers choose whether to accept one of the offers or reject all of them: if a firm has an offer accepted by it's customer and by at least one employee the game ends for that firm: if the firm's offer is rejected by either the customer or by all the employees then the game moves to a second stage (for that firm) where services can only be provided outside the firm's premises and the employees make take-it-or-leave-it offers to the remaining customer(s): the customer(s) then accept(s) or reject(s) the offer and the game ends.

Solving this game backwards:

- Bertrand competition between employees results in equilibrium payoffs in the second stage of the bargaining game where employee E_{11} gets $\bar{v} - \underline{v}$, each customer C_i gets $\underline{v}$, and the other employees E_{ij} get 0.

- In the first stage of the game, when $f' \geq 1$. Bertrand competition for the good employee results in a wage for employee $E_{11}$of $\bar{V} - \underline{V}$ and a wage of 0 for the other employees. Each customer gets $\underline{v}$ and the four employee-owners each get $\frac{1}{2}(\underline{V} - \underline{v})$.

Thus, when $f' \geq 1$ the bargaining solution under employee cooperative is given by:

Agent:	employee E_{11}	employee E_{ij}	outside owner O_i	customer C_i
share:	$\overline{V} - \frac{1}{2}(\underline{V} + \underline{v})$	$\frac{1}{2}(\underline{V} - \underline{v})$	0	$\underline{v}$

- When $f' < 1$, so that, $\overline{V} - \underline{V} < \overline{v} - \underline{v}$, the bargaining solution is:

Agent:	employee E_{11}	employee E_{ij}	outside owner O_i	customer C_i
share:	$\frac{1}{2}(\overline{v} + \overline{V}) - \underline{v}$	$\frac{1}{2}(\overline{V} - \overline{v})$	0	$\underline{v}$

These payoffs then translate into the following ex-ante investment choices for the employees. When $f' \geq 1$ they choose their investment in human capital k_i to maximize:

$$\max_{k_i \geq 0} \{ \frac{1}{4} f(\lambda \log(1 + k_i)) - k_i \} \tag{13}$$

and when $f' < 1$ they choose k_i to maximize:

$$\max_{k_i \geq 0} \{\frac{1}{8}(\lambda \log(1+k_i) + f(\lambda \log(1+k_i))) - k_i\} \tag{14}$$

We therefore obtain the following solution for the investment choices under employee cooperative.

Lemma 12 *The equilibrium human capital investment levels under employee cooperative are given by:*

$$\max\{0, k_{ij}^E\}$$

where,

$$k_{ij}^E = \begin{cases} \frac{\lambda}{4} f' - 1, \text{ if } f' \geq 1 \\ \frac{\lambda}{4}(\frac{f'}{2} + \frac{1}{2}) - 1, \text{ otherwise} \end{cases}$$

Thus, as under outside ownership, when $f' \geq 1$ perfect competition gives employees the correct marginal incentives to invest ex ante: when $f' < 1$, employees will over-invest. However, under the employee ownership the employees over-invest less than that under the outside ownership.

Comparing Ownership Allocations

The analysis in this section highlights the positive effects of external competition on incentives under all three ownership allocations. When competition in labor markets is perfect then the first-best is achieved under all three ownership structures whenever $f' \geq 1$. If, however, $f' < 1$, then external competition has no effect on investment incentives and the ranking of ownership structures remains the same as in the previous section: customer cooperative is best and achieves the socially efficient outcome: it is followed by employee cooperative, which in turn dominates outside ownership. We summarize the discussion in this section in the following proposition:

Proposition 4 *When there is no lock-in, employees are homogeneous, and $f' \geq 1$, ownership is irrelevant. When $f' < 1$ ownership matters and the ranking of ownership allocations is: customer cooperative is the most efficient allocation, followed by employee cooperative and outside ownership.*

Heterogeneous Employees and Excess Supply of Ordinary Employees (scratch)

Now we introduce heterogeneity of laborers and more labor market competition into our model. We assume that the economy has two firms and need total 4 employees: all the employees' ex-post capabilities are different (but they are the same ex-ante): two are good, two are bad, and two are in the middle: and the two bad ones are of no use. Moreover, again we assume that there is no product competition (e.g. all products have demand).

We denote the two firms by m_1 and m_2: the three employees in each firm by E_{11}, E_{12}, E_{13} and E_{21}, E_{22}, E_{23}: and the two customers in each firm by C_{11}, C_{12} and C_{21}, C_{22}. Each firm can serve only two customers, so that there is no competition between firms in the product market. Customers are identical and firm have identical assets. That is, for any of the four employees we have $V_1(k_i) = V_2(k_i)$. To simplify the model, we assume that ownership is determined ex-ante and there is no trade of ownership titles ex-post.

Employee E_{ij} has a α_{ij} probability of being a good employee and $\sum_{i,j} \alpha_{ij} = 1$. Ex-post, among all employees there are two good ones with values of v^1 and v^2 (i.e. $v^g = v^1, v^2$; and $v^1 > v^2$) respectively each with the same probability of $\frac{\alpha_{ij}}{2}$; moreover, there are four ordinary ones with values of $v^3 = v^4 = v^m > v^5 = v^6 = v^b$ respectively with the same probability of $\frac{1-\alpha_{ij}}{4}$; and denote them as middles ones (v^m) and bad ones (v^b). Formally, by investing k_{ij} in human capital employee E_{ij} gets an ex-post value of

$$v_{ij}(k_{ij}) = \begin{cases} \lambda^t \log(1 + k_{ij}), & \text{with probability } 1 - \alpha_{ij} \\ \lambda^g \log(1 + k_{ij}), & \text{with probability } \alpha_{ij}. \end{cases}$$

where $\lambda^g > 1$ and $g = 1, 2$; and $\lambda^t < 1$, and $t = m, b$; moreover, $\lambda^m > \lambda^b$. Ex-ante it is not known how each employee E_{ij} is ranked. Here, we assume that the value of the firm's product is the highest as long as there is a good employee and a middle employee, i.e., $V\left(k^g, k^m, k^b\right) = V\left(k^g, k^g, k^m\right) = V\left(k^g, k^m, k^m\right) = V\left(v_g\left(k^g\right), v_m\left(k^m\right)\right) = \bar{V} > V^g + V^m$, where, $\bar{V} = f\left(v_g\left(k^g\right), v_m\left(k^m\right)\right)$ and $f''_{k^g k^m}\left(k^g, k^m\right) \equiv \frac{\partial^2 f\left(k^g, k^m\right)}{\partial k^g \partial k^m} = 0$.[9] Moreover, $V\left(k^1, k^m, k^b\right) \equiv \bar{V}^1 > V\left(k^2, k^m, k^b\right) \equiv \bar{V}^2$, that implies that there will be a competition for E^1.

From the above set up, it is obvious that at equilibrium, each of the two firms in the economy will have one good, one middle, and one bad employee.

[9] The technical assumption $f''_{k^g k^m}\left(k^g, k^m\right) = 0$ is made to keep the model simple. It is not critical for our results.

It is easy to see that the first best solution of the social planners program is

$$k_{ij}^{*} = \frac{\alpha_{ij} f'}{2} \left(\lambda^1 + \lambda^2\right) + \frac{f'}{2} \left(1 - \alpha_{ij}\right) \lambda^m - 1.$$

Partnership

In this case, we suppose that only one of the employees is the owner (partner) of the firm. When a good employee is the owner, then the value of the firm is $\bar{V}^g$, $g = 1, 2$. Since in the economy there is an over supply of ordinary employees, a bad employee does not produce value and the bargaining solution is given by:

Agent:	partner E^g	employee E^m	employee E^b	customer C_i
share:	$\bar{V} - v^m$	$v^m - v^b$	0	v^b

where, $g = 1, 2$; $m = 3, 4$; and $b = 5, 6$.

If the owner is a middle employee, when $f' > 1$, then bargaining solution is the following:[10]

Agent:	employee E^1	partner E^m	employee E^b	customer C_i
share:	$\bar{V}^1 - \bar{V}^2$	$\bar{V}^2 - v^b$	0	v^b

in the case that the firm hires E^1; or

Agent:	employee E^2	partner E^m	employee E^b	customer C_i
share:	v^2	$\bar{V}^2 - v^2 - v^b$	0	v^b

in the case that the firm hires E^2.

If the owner is a bad employee, then bargaining solution is the following.

Agent:	employee E^1	employee E^m	partner E^b	customer C_i
share:	$\bar{V}^1 - \bar{V}^2$	$v^m - v^b$	$\bar{V}^2 - v^m$	v^b

in the case that the firm hires E^1; or

Agent:	employee E^2	employee E^m	partner E^b	customer C_i
share:	$v^2 - v^b$	$v^m - v^b$	$\bar{V}^2 + v^b - v^2 - v^m$	v^b

in the case that the firm hires E^2.

Hence, the partner and non-partner employees E^p and E^n choose their human capital investments, k_p and k_n, to solve respectively:

$$\max_{k_p \geq 0} \{ \frac{\alpha_p}{2} \sum_{g=1}^{2} f(\lambda^g \log(1 + k_p)) + \frac{1 - \alpha_p}{4} \sum_{m=3}^{4} f(\lambda^m \log(1 + k_p)) - k_p \} \qquad (15)$$

[10] We suppose that $\bar{V}^1 - \bar{V}^2 > v^1$.

and,

$$\max_{k_n \geq 0}\{\frac{\alpha_n}{2}\left(f'\lambda^1 \log(1+k_n) + \lambda^2 \log(1+k_n)\right) + \frac{1-\alpha_n}{2}\lambda^m \log(1+k_n) - k_n\} \qquad (16)$$

We thus obtain the following solution for the equilibrium investment levels in human capital under a partnership (here E_p-ownership):

Lemma 13 *The equilibrium investment levels under the E_p-partnership are:*

$$k_p^{E_p} = \frac{\alpha_p f'}{2}\left(\lambda^1 + \lambda^2\right) + \frac{(1-\alpha_p)\, f'}{2}\lambda^m - 1. \text{ for the partner } E_p\text{: and}$$

$$k_n^{E_p} = \frac{\alpha_n}{2}\left(f'\lambda^1 + \lambda^2\right) + \frac{(1-\alpha_n)}{2}\lambda^m - 1, \text{ for the non-owner employee } E_n.$$

That is, the partner invest at first best level: while the non-partner employee will underinvest if $f' > 1$.

Employee Coop

- Bertrand competition between employees results in equilibrium payoffs in the second stage of the bargaining game where employee E^1 gets $v^1 - v^2$, each customer C_{ij} gets v^5, other employees E^s get $v^s - v^{s+1}$ and the worst two employees E^t get 0.
- In the first stage of the game, when $f' \geq 1$, Bertrand competition for the good employee results in a wage for employee E^1 of $\bar{V}^1 - \bar{V}^2$, and a wage of 0 for the other employees. Each customer gets v^b and all the employee-owners divide the residual equally, i.e. each gets $\frac{1}{3}(\bar{V}^2 - v^b)$. Note that this equal sharing rule will lower the marginal incentives of an employee being a middle one ex post, without improving any other cases. Thus it is the source of an inefficiency.

Thus, when $f' \geq 1$ the bargaining solution under employee cooperative is given by[11]:

Agent:	employee E^1	employee E^s	customer C_i
share:	$\bar{V}^1 - \bar{V}^2 + \frac{1}{3}(\bar{V}^2 - v^b)$	$\frac{1}{3}(\bar{V}^2 - v^b)$	v^b

where $s = 2, m, b$.

These payoffs then translate into the following ex-ante investment choices for the employees. When $f' \geq 1$ they choose their investment in human capital k_i to maximize:

[11] Here we assume also that $\frac{1}{3}(V^2 - v^5) \geq v^2 - v^3$.

When $f' < 1$, so that, $V^1 - V^2 < v^1 - v^2$, and $\frac{1}{3}(V^2 - v^5) \geq v^2 - v^3$, the bargaining solution is:

Agent:	employee E^1	employee E^s	employee E^t	customer C_i
share:	$v^1 - v^2 + \frac{1}{3}(V^2 - v^5)$	$\frac{1}{3}(V^2 - v^5)$	$\frac{1}{3}(V^2 - v^5)$	v^5

$$\max_{k_{ij}\geq 0}\left\{\begin{array}{l}\frac{\alpha_{ij}}{2}\left[f\left(\lambda^1\log(1+k_{ij})\right)+\frac{1}{3}\lambda^2\log(1+k_{ij})\right]\\ +\frac{1-\alpha_{ij}}{6}\left[\left(f'\lambda^m-\lambda^b\right)\log(1+k_{ij})\right]-k_{ij}\end{array}\right\} \tag{17}$$

We therefore obtain the following solution for the investment choices under employee cooperative.

Lemma 14 *If $f' \geq 1$, the equilibrium human capital investment levels under employee cooperative are given by:*

$$k_{ij}^{EC}=\frac{\alpha_{ij}}{2}\left[f'\lambda^1+\frac{\lambda^2}{3}\right]+\frac{1-\alpha_{ij}}{6}\left(f'\lambda^m+\lambda^b\right)-1.$$

Outside ownership

When $f' \geq 1$ the bargaining solution under outside ownership is given by:

Agent:	employee E^1	employee E^m	employee E^b	outside owner O_i	customer C_{ij}
share:	$\bar{V}^1-\bar{V}^2$	v^m-v^b	0	$\bar{V}^2-v^m$	v^b

if the firm hires E^1; or

Agent:	employee E^2	employee E^m	employee E^b	outside owner O_i	customer C
share:	v^2-v^b	v^m-v^b	0	$\bar{V}^2+v^b-v^2-v^m$	v^b

if the firms hires E^2.

These payoffs then translate into the following ex-ante investment choices for the employees. When $f' \geq 1$ they choose k_{ij} to maximize:

$$\max_{k_{ij}\geq 0}\left\{\frac{\alpha_{ij}}{2}\left[f\left(\lambda^1\log(1+k_{ij})\right)+\lambda^2\log(1+k_{ij})\right]+\frac{1-\alpha_{ij}}{2}\lambda^m\log(1+k_{ij})-k_{ij}\right\} \tag{18}$$

We thus obtain the following solution for the investment choices under outside ownership.

Lemma 15 *The equilibrium human capital investment levels under outside ownership are given by*

$$k_{ij}^{O}=\frac{\alpha_{ij}}{2}\left[f'\lambda^1+\lambda^2\right]+\frac{1-\alpha_{ij}}{2}\lambda^m-1, \text{ if } f'\geq 1.$$

That is, when the complementarity is strong, the outside ownership will under-invest.

Customer Cooperative

When $f' \geq 1$ we have:

Agent:	employee E^1	employee E^m	employee E^b	customer-owner C
share:	$\bar{V}^1-\bar{V}^2$	v^m-v^b	0	$\bar{V}^2+v^b-v^m$

if E^1 is hired: or

Agent:	employee E^2	employee E^m	employee E^b	customer-owner C_{ij}
share:	$v^2 - v^b$	$v^m - v^b$	0	$\bar{V}^2 + 2v^b - v^2 - v^m$

Then each employee chooses his initial investment in human capital k_i to maximize:

$$\max_{k_{ij} \geq 0} \left\{ \frac{\alpha_{ij}}{2} \left[f\left(\lambda^1 \log(1 + k_{ij})\right) + \lambda^2 \log(1 + k_{ij}) \right] + \frac{1 - \alpha_{ij}}{2} \lambda^m \log(1 + k_{ij}) - k_{ij} \right\} \quad (19)$$

So that equilibrium investment levels are given by:

Lemma 16 *The equilibrium human capital investment levels under customer cooperative are given by:*

$$k_{ij}^C = \frac{\alpha_{ij}}{2} \left[f' \lambda^1 + \lambda^2 \right] + \frac{1 - \alpha_{ij}}{2} \lambda^m - 1.$$

That is. the customer coop is the same as the outside ownership. Looking at the case of $f' \geq 1$. now we have the following results.

Proposition 5 *When there is no lock-in, and is an excess supply of ordinary employees, under all ownership structures. employees under-invest. The efficiency ranking of different ownership structures is the following:*

1. outside ownership is the same as the customer coop:
2. partnership is the most efficient ownership structure: under the partnership.
   - the partner's incentive achieves the first best:
   - the employee's incentives is the same as in the outside (or customer) ownership;
3. employee coop is the worst.

An immediate implication from the above result is that if the one has the highest chance being the best employee is the partner. then partnership can be even more efficient.

MARKET STRUCTURE (HORIZONTAL INTEGRATION)

In this section we briefly consider the effects of horizontal integration under the three different ownership structures. Two basic lessons emerge from this analysis. First. integration always reduces welfare by distorting investment incentives. although it may raise the owners' payoff. Second. the effects of integration on incentives vary with the ownership allocation. Integration is worst under outside ownership. followed by employee

cooperative. It has no effect under customer cooperative. Although these are not entirely surprising results, they could have important implications for antitrust policy.

We model integration of the two firms as in section IV, with the difference that instead of having two employees in the firm we have four. The bargaining solution in the integrated firm under outside ownership is then as before, so that employees invest $k_I^O = \frac{\lambda}{4} - 1$ under outside ownership. Similarly, under customer cooperative the bargaining solution remains unchanged and employees invest $k_I^C = \frac{\lambda f'}{4} - 1$. Finally, under employee cooperative the bargaining solution is changed only to the extent that now four employees share the surplus ownership provides instead of just two. Thus, under employee cooperative, employees invest $k_I^E = \frac{\lambda}{4}(\frac{f'}{4} + \frac{3}{4}) - 1$.

Comparing these investment levels to those obtained under non-integration we can immediately conclude that when there is no lock-in of customers in firms then integration is always counterproductive from an efficiency perspective. It has no effect on investment incentives under customer cooperative, but it strictly decreases investment incentives under either outside or employee cooperative. The worst impact of integration is under outside ownership when $f' \geq 1$.

Note, however, that if there is perfect lock-in integration could be an efficient institutional response to overcome this constraint. That is, by integrating the two firms could increase the extent of internal competition and thereby improve incentives.

CONCLUDING REMARKS

Our paper provides a uniform framework within which both competition within and across firms can be considered. To our knowledge this is the first attempt to consider both forms of competition within a single framework. Most of the existing literature either deals with only internal competition or only external competition.

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