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ABSTRACT

Joint Ownership and the Hold-up Problem Under Asymmetric Information

In the standard property rights approach to the theory of the firm, joint ownership cannot be optimal, because it induces smaller investments in human capital than ownership by a single party. This result holds under the assumption that bargaining is always ex post efficient due to symmetric information. However, joint ownership can be optimal if the parties have private information about the payoffs that they can realize on their own.

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1 Introduction

Starting with the seminal contributions of Grossman and Hart (1986) and Hart and Moore (1990), many authors have studied the optimal allocation of ownership rights in the context of the hold-up problem, which occurs when contractual parties can make relationship-specific investments. A prominent conclusion of this literature says that joint ownership of an asset cannot be optimal, provided that the investments improve the parties' human capital only (i.e., they are not embodied in the physical asset; see Hart, 1995).

An important assumption of the standard property rights approach to the theory of the firm is that ex post bargaining is always efficient, because there is symmetric information. This assumption, which has been sharply criticized by Williamson (2002), will be relaxed in the present paper. It turns out that then joint ownership can be optimal.

According to the property rights approach, ownership of an asset can enhance a party's investment incentives, because it improves the default payoff that a party can realize on its own (and hence the party's position in ex post bargaining). Consider two parties, A and B, who can invest in their human capital. It is ex post efficient for them to collaborate after the investments are sunk. Surplus can be generated with an essential asset only. Under joint ownership, each party has veto power over the use of the asset, so that the parties' default payoffs are zero.

Consider A-ownership. First, assume that there is symmetric information. Party B's default payoff is still zero, but party A can make some profit even if no agreement with party B is reached (this profit will be smaller than the collaboration surplus, because party B's human capital is absent). Hence, party A will invest more under A-ownership than under joint ownership (while party B's investment incentives remain unchanged). Assume now that there is asymmetric information; i.e., after the investments are sunk, party A privately learns its default payoff, which seems to be plausible.[1] In this case, bargaining will not always be ex post efficient. As

[1] Holmström (1999) already pointed out that the assumption according to which both parties observe the default payoffs deserves more scrutiny.

a consequence, party B's investment incentives under A-ownership can be *smaller* than under joint ownership. The arguments are symmetric in the case of B-ownership. Thus, if both parties privately learn their default payoffs, joint ownership can be better than both A- and B-ownership.

It has already been emphasized by Holmström (1999) that joint ventures are an important part of the corporate landscape, so the standard prediction that joint ownership cannot be optimal seems to be counterfactual. Some authors have argued that joint ownership can be explained in repeated settings. Specifically, Halonen (2002) considers an infinitely repeated game and argues that joint ownership may be optimal since the fact that it generates a poor static equilibrium can turn it into a superior punishment device.[2] Moreover, joint ownership can be optimal if there are direct externalities on the other party's default payoff (see Rosenkranz and Schmitz, 1999). Yet, these models keep the assumption that there is symmetric information.

The present paper is most closely related to Schmitz (2006), where asymmetric information has been introduced into the property rights approach. Yet, Schmitz (2006) considers only one-sided investments, so the optimality of joint ownership could not be demonstrated there.

2 The model

There are two risk-neutral parties, A and B, who can by collaboration at some future date $t = 2$ generate a surplus $v_0 + v_A(a) + v_B(b) \geq 0$.[3] The surplus can be produced with an essential physical asset (e.g., a production plant). At date $t = 0$, the parties agree on an ownership structure $o \in \{A, B, J\}$ over the physical asset. Ownership by a single party ($o = A$ or $o = B$) means that the asset cannot be used without the owner's consent. Joint ownership ($o = J$) means that each party has veto power over the use

[2] See also Rosenkranz and Schmitz (2003, 2004), who consider finitely repeated games.

[3] The technology is assumed to have an additive structure in order to keep the exposition as simple as possible. Similar assumptions are often made in the incomplete contracting literature, see e.g. Aghion and Tirole (1994), Hart (1995), or Hart, Shleifer, and Vishny (1997).

of the asset.[4] At date $t = 1$, party A chooses an investment level $a \geq 0$ and simultaneously party B chooses an investment level $b \geq 0$. The investments are observable but unverifiable and they are measured by their costs. Each party can invest only in its human capital. Finally, at date $t = 2$ the parties bargain about whether or not to collaborate.

The parties can make up-front lump-sum payments to each other, so that at date $t = 0$ they always agree on an ownership structure that maximizes the expected total surplus. No further contractual arrangements are possible at date $t = 0$. In particular, the parties cannot commit ex ante to collaborate ex post, because the specific nature of the collaboration cannot be specified before date $t = 2$.[5]

The parties' default payoffs, i.e. what they get if they fail to collaborate at date $t = 2$, depend on the ownership structure as follows. If party A is the sole owner ($o = A$) and no agreement is reached at date $t = 2$, then party B gets zero (since B does not have access to the essential asset) and party A's payoff is $v_0^A + v_A(a) \geq 0$, where $v_0^A \in [0, v_0]$. Party A can use the asset without party B's collaboration, but then party A cannot make use of party B's human capital. If party B controls the physical asset ($o = B$), then analogously party A's default payoff is zero, while party B's default payoff is $v_0^B + v_B(b) \geq 0$, where $v_0^B \in [0, v_0]$. Finally, in the case of joint ownership ($o = J$) both parties' default payoffs are zero.

In accordance with the standard property rights model, collaboration is always ex post efficient. However, in contrast to the standard model, party A may have some private information about the payoff that it can realize on its own. Specifically, let v_0^A and v_0^B be independently distributed random variables, which are realized at date $t = 1.5$. We will compare two scenarios. In scenario I, there is symmetric information (i.e., either both parties learn the realizations of v_0^A and v_0^B or both parties remain ignorant). In scenario

[4] This is the usual definition of joint ownership in the property rights theory (see Hart, 1995).

[5] While these assumptions are now standard in the incomplete contracting literature, they are still a matter of ongoing discussions. See Maskin and Tirole (1999) and Tirole (1999).

II, there is asymmetric information; i.e., at date $t = 1.5$ only party A learns the realization of v_0^A and only party B learns the realization of v_0^B.

At date $t = 2$, the parties bargain over whether or not to collaborate. For simplicity, assume that party A can make a take-it-or-leave-it offer with probability $\alpha \in (0, 1)$, and party B can make a take-it-or-leave-it offer with probability $1-\alpha$. This is the simplest non-cooperative bargaining game that is consistent with the standard property rights approach.[6]

The following technical assumptions are made. Let $v_A(\cdot)$ and $v_B(\cdot)$ be twice differentiable functions with $v_i(0) = 0$, $v_i'(x) > 0$, $v_i''(x) < 0$, $\lim_{x\to 0} v_i'(x) = \infty$, and $\lim_{x\to\infty} v_i'(x) = 0$, where $i \in \{A, B\}$, $x \geq 0$. Moreover, let v_0^i be distributed according to the distribution function $F_i(\cdot)$ and let the corresponding density function $f_i(\cdot)$ be strictly positive on the interval $[0, v_0]$. For simplicity, assume that the standard monotone hazard rate condition is satisfied, so that $v_0^i + F_i(v_0^i)/f_i(v_0^i)$ is increasing. With the possible exception of the realizations of the random variables, all components of the model are assumed to be common knowledge among the two parties.

In the first-best benchmark solution, the parties collaborate at date $t = 2$ and the ex ante efficient investment levels are characterized by the first-order conditions

$$v_A'(a^{FB}) = 1 \text{ and } v_B'(b^{FB}) = 1.$$

The total surplus is $S^{FB} = v_0 + v_A(a^{FB}) + v_B(b^{FB}) - a^{FB} - b^{FB}$.

3 Investment incentives

Let us now analyze the parties' investment incentives under the different ownership structures. First, consider A-ownership ($o = A$). With probability α, party A can make the offer at date $t = 2$. Party A will collaborate if it gets the whole pie $v_0 + v_A(a) + v_B(b)$, which will be accepted by party B, because B's default payoff is zero. When party B can make the offer

[6] This simple bargaining game has also been used by Hart and Moore (1999) and Bajari and Tadelis (2001). If the parties are symmetrically informed, the bargaining game obviously leads to the generalized Nash bargaining solution, where α is party A's bargaining power.

and the parties are ignorant (i.e., symmetrically uninformed), party B will collaborate if party A accepts to get $E[v_0^A + v_A(a)]$, which party A will do (because party A can realize the payoff $v_0^A + v_A(a)$ on its own). If both parties know the realization of v_0^A, then party B collaborates if party A accepts to get $v_0^A + v_A(a)$, which party A will do.

Hence, if there is symmetric information (regardless of whether the parties are symmetrically informed or uninformed), then at date $t = 1$ party A's expected payoff is $\alpha[v_0 + v_A(a) + v_B(b)] + (1-\alpha)E[v_0^A + v_A(a)] - a$ and party B's expected payoff is $(1-\alpha)\left(v_0 + v_B(b) - E[v_0^A]\right) - b$. The investment levels in scenario I are thus characterized by[7]

$$v_A'(a^A) = 1 \text{ and } (1-\alpha)v_B'(b^A) = 1,$$

and the total surplus is $S^A = v_0 + v_A(a^A) + v_B(b^A) - a^A - b^A$.

If there is asymmetric information (scenario II), nothing changes when party A can make the offer. When party B can make the offer, then there will be collaboration if party A accepts to get $p_A^* + v_A(a)$, where $p_A^* = \arg\max[v_0 + v_B(b) - p_A]F_A(p_A)$. In order to see this, note that party A accepts to collaborate if it gets at least $v_0^A + v_A(a)$. Hence, if collaboration yields $p_A + v_A(a)$ to party A,[8] then it will accept whenever $p_A \geq v_0^A$, which happens with probability $F_A(p_A)$.

The first derivative of party B's expected payoff $[v_0 + v_B(b) - p_A]F_A(p_A)$ with respect to p_A reads $[v_0 + v_B(b) - p_A]f_A(p_A) - F_A(p_A)$. The first-order condition for an interior solution thus is

$$v_0 + v_B(b) = p_A + \frac{F_A(p_A)}{f_A(p_A)}.$$

Due to the monotone hazard rate assumption, the right-hand side strictly increases from 0 to $v_0 + 1/f_A(v_0)$ when p_A moves from 0 to v_0. Thus, if $v_B(b) \leq 1/f_A(v_0)$, then p_A^* is uniquely characterized by $v_0 + v_B(b) = p_A^* + F_A(p_A^*)/f_A(p_A^*)$, otherwise $p_A^* = v_0$.

[7] Throughout, the superscript A, B, or J refers to the ownership structure $o \in \{A, B, J\}$.

[8] It follows from standard Bayesian mechanism design (see e.g. Maskin and Riley, 1984), that party B can confine its attention to the simple posted-price mechanisms analyzed here.

Hence, under asymmetric information, at date $t = 1$ party A's expected payoff reads $\alpha[v_0 + v_A(a) + v_B(b)] + (1-\alpha)E[\max\{p_A^*, v_0^A\} + v_A(a)] - a$ and party B's expected payoff is $(1-\alpha)[v_0 + v_B(b) - p_A^*]F_A(p_A^*) - b$. Given A-ownership, the investment levels in scenario II are thus characterized by

$$v_A'(\bar{a}^A) = 1 \text{ and } (1-\alpha)F_A(p_A^*)v_B'(\bar{b}^A) = 1,$$

where $[(v_0 + v_B(b) - p_A^*)\, f_A(p_A^*) - F_A(p_A^*)]\, dp_A^*/db = 0$ has been used. The expected total surplus is

$$\begin{aligned} \bar{S}^A &= [\alpha + (1-\alpha)F_A(p_A^*)]\left(v_0 + v_A(\bar{a}^A) + v_B(\bar{b}^A)\right) \\ &\quad +(1-\alpha)\int_{p_A^*}^{v_0} \left(w + v_A(\bar{a}^A)\right) dF_A(w) - \bar{a}^A - \bar{b}^A. \end{aligned}$$

Next, consider B-ownership ($o = B$). Using analogous arguments, it is now straightforward to show that the investment levels under symmetric information (scenario I) are characterized by

$$\alpha v_A'(a^B) = 1 \text{ and } v_B'(b^B) = 1,$$

and the total surplus is $S^B = v_0 + v_A(a^B) + v_B(b^B) - a^B - b^B$. Under asymmetric information (scenario II), the investment levels are given by

$$\alpha F_B(p_B^*)v_A'(\bar{a}^B) = 1 \text{ and } v_B'(\bar{b}^B) = 1,$$

where $p_B^* = \arg\max[v_0 + v_A(a) - p_B]F_B(p_B)$. The expected total surplus is $\bar{S}^B = [1-\alpha+\alpha F_B(p_B^*)]\left(v_0 + v_A(\bar{a}^B) + v_B(\bar{b}^B)\right) + \alpha\int_{p_B^*}^{v_0}\left(w + v_B(\bar{b}^B)\right) dF_B(w) - \bar{a}^B - \bar{b}^B$.

Finally, consider joint ownership ($o = J$). Since both parties have veto power, the default payoffs are zero, so the party that can make the offer gets the whole pie. Hence, at date $t = 1$, party A's payoff is $\alpha[v_0 + v_A(a) + v_B(b)] - a$ and party B's payoff is $(1-\alpha)[v_0 + v_A(a) + v_B(b)] - b$. The investment levels under joint ownership are characterized by

$$\alpha v_A'(a^J) = 1 \text{ and } (1-\alpha)v_B'(b^J) = 1,$$

and the total surplus is $S^J = v_0 + v_A(a^J) + v_B(b^J) - a^J - b^J$.

4 The main results

The first-order conditions that have been derived in the preceding section immediately imply the following result.

Proposition 1 *The investment levels of the two parties satisfy*

$$\bar{a}^B \leq a^J = a^B < a^A = \bar{a}^A = a^{FB},$$

$$\bar{b}^A \leq b^J = b^A < b^B = \bar{b}^B = b^{FB}.$$

Given symmetric information, party A invests the same amount under $o = J$ and $o = B$. The reason is that in both cases, the parties always agree on collaboration, party A's default payoff is zero, and party B's default payoff is independent of party A's investment. In contrast, when party B is the owner and has private information, agreement will not always be reached, so that party A's incentives to invest can be smaller than under joint ownership. Hence, the following result holds.

Proposition 2 *(i) Under symmetric information (scenario I), joint ownership can never be better than ownership by a single party:* $S^J < \min\{S^A, S^B\}$.

(ii) Under asymmetric information (scenario II), joint ownership can be optimal; i.e., it is possible that $S^J > \max\{\bar{S}^A, \bar{S}^B\}$ *holds.*

Part (i) replicates the standard finding, according to which joint ownership of an asset can never be optimal. The result follows immediately from $a^J = a^B < a^A$ and $b^J = b^A < b^B$. Since there is never overinvestment with regard to the first-best solution, $o = J$ cannot be optimal, because under $o \in \{A, B\}$ the owner invests more, and ex post efficiency is achieved in any case.[9]

Part (ii) says that the standard result can be overturned under asymmetric information, because then $\bar{a}^B \leq a^J < \bar{a}^A$ and $\bar{b}^A \leq b^J < \bar{b}^B$ hold. Joint ownership avoids ex post inefficiencies, while $o \in \{A, B\}$ may lead to

[9] Note that if *only one* party can have private information, joint ownership cannot be better than ownership by the other party (i.e., if only party A has private information, then $S^J < S^B$).

smaller investments by the non-owner, which can overcompensate the larger investments of the owner.

As an illustration, consider Figure 1. If the parties are symmetrically informed (scenario I), the expected total surplus under A- and B-ownership is depicted by the curves S^A and S^B, respectively. Both curves are above the one that shows S^J, the surplus under joint ownership. If there is asymmetric information (scenario II), the surplus under A- and B-ownership is depicted by the curves $\bar{S}^A$ and $\bar{S}^B$. In this case, $o = A$ is optimal only if party A's bargaining power α is very small (so that giving party A investment incentives is very important). Similarly, $o = B$ is optimal only if B's bargaining power $1 - \alpha$ is very small. For intermediate values of α, joint ownership is optimal.[10]

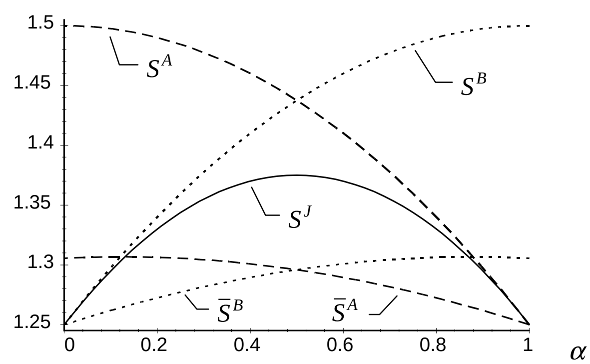

Figure 1. Joint ownership can be optimal.[11]

[10]In the example in Figure 1, $v_0 = 1$, $v_A(a) = a^{1/2}$, $v_B(b) = b^{1/2}$, and v_0^A and v_0^B are uniformly distributed on $[0, 1]$. In scenario II, joint ownership is optimal if $\alpha \in (\underline{\alpha}, \overline{\alpha})$, where $\underline{\alpha} \approx 0.13$ and $\overline{\alpha} \approx 0.87$.

[11]While it is usually assumed in the property rights theory that the bargaining power α is exogenously given (see Hart, 1995), in some cases it might be possible to allocate bargaining power (cf. Hart and Moore, 2007). Note that under symmetric information (so that $o \in \{A, B\}$ will be chosen), it is desirable to allocate all the bargaining power to the non-owner. In contrast, if the parties agree on $o = J$ due to asymmetric information, then the total surplus is maximized if both parties have equal bargaining strengths.

5 Concluding remarks

Thus far, it has been assumed that a party costlessly learns its default payoff. Alternatively, one could assume that a party can invest in information gathering (see Schmitz, 2006). Note that in the present setting (where collaboration is always ex post efficient) information gathering is a pure rent-seeking activity. Hence, if the information structure is endogenized, joint ownership may be optimal for an even larger set of parameter constellations, because it avoids wasteful rent-seeking.

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