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Abstract

We reconsider the property rights approach to the theory of the firm based on incomplete contracts. We explore the implications of different degrees of relationship-specificity when there are two parties, A and B, who can make investments in physical capital (instead of human capital). If relationship-specificity is exogenously given, it turns out that joint asset ownership can be optimal only if the degree of relationship-specificity is sufficiently small. If relationship-specificity can be freely chosen and if party A's investments are more productive, then the parties deliberately choose a strictly positive level of relationship-specificity and they always agree on sole ownership by party A.

Keywords: ownership, incomplete contracts, relationship-specificity, theory of the firm, investment incentives

JEL Classification: D23; D86; C78; L22; L24

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1 Introduction

The property rights approach to the theory of the firm (Grossman and Hart, 1986; Hart and Moore, 1990; Hart, 1995) is one of the major achievements in microeconomic research in the past three decades, as it provides a formal framework to analyze basic questions about economic institutions such as firms that were first raised by Coase (1937).[1] In a nutshell, given that contracts are incomplete, a party's incentives to make relationship-specific investments depend on the fraction of the investments' returns that the party can capture in future negotiations. Asset ownership matters, because ownership improves a party's position in the case that future negotiations fail, and hence ownership increases the fraction of the investments' returns that a party will be able to capture in the negotiations.

The standard model of the property rights approach considers a party's investments in its *human capital* only (see Hart, 1995). In this case, it turns out that joint ownership of an asset by two parties cannot be optimal. Under joint ownership, each party has veto power over the use of the asset. Making instead one party the sole owner of the asset improves this party's incentives to invest in its human capital, while the other party's investment incentives are not changed. However, Hart and Moore (1990, pp. 1132–1133) and Hart (1995, pp. 68–69) briefly point out that joint ownership can be optimal if the parties invest in *physical capital*, so that both parties' investments can be used by a single asset owner, even in the case that negotiations fail. Joint ownership

[1] See Hart (2011) for a concise survey of the modern theory of the firm. See also Segal and Whinston (2010) for a comprehensive review of the related literature.

can be optimal in the presence of physical capital investments, because under sole ownership the non-owner improves the owner's bargaining position by investing, so that under joint ownership one of the two parties has stronger investment incentives.

In the present paper, we take a closer look at investments in physical capital, which have been largely neglected in the literature on the property rights approach. In particular, we analyze the impact of the investments' relationship-specificity on the optimality of joint ownership, an issue that to the best of my knowledge has been unexplored so far.

In a first step, we assume that the degree of relationship-specificity is exogenously given. It turns out that joint ownership can be optimal only if the investments are not too relationship-specific. Otherwise, the party whose investments are more productive should be the owner (just as in the standard case where investments are in human capital).

In a second step, we endogenize the degree of relationship-specificity. Suppose that party A's investments are more productive than party B's investments. It turns out that if the degree of relationship-specificity can be freely chosen, then joint ownership cannot be optimal, even when investments are in physical capital. Instead, the parties will agree on A-ownership. Moreover, while in case of investments in human capital the parties would prefer to completely remove any relationship-specificity, in case of investments in physical capital the parties deliberately choose a positive level of relationship-specificity.

2 The model

Consider two parties, A and B. At some initial date 0, the parties agree on an ownership structure $o \in \{A, B, J\}$. Since the parties are symmetrically informed and there are no wealth constraints, they will agree on the ownership structure that maximizes their anticipated total surplus, which they can divide up-front by suitable lump-sum payments.[2] For instance, party B could be the supplier of an intermediate good, which party A may use to produce a final good. The owner has the control rights over the assets needed to produce the intermediate good. A-ownership can then be interpreted as integration and B-ownership as non-integration, while $o = J$ means that there is joint ownership.

At date 1, the two parties simultaneously make investments $a \geq 0$ and $b \geq 0$, respectively, which are observable but not contractible. The investments are made in the physical capital; i.e., they are embodied in the assets. Let the parties' investment costs be given by $c(a) = \frac{1}{2}a^2$ and $c(b) = \frac{1}{2}b^2$.

At date 2, the parties negotiate about whether or not to collaborate.[3] If the parties agree on collaboration, then they together generate the date-2 surplus $a + \xi b$. The technology parameter ξ indicates whether party A's investments

[2] Note that ex-ante bargaining determines only the division of the anticipated surplus, but not its size; hence, we follow the standard property rights models by not modelling the ex-ante negotiations explicitly.

[3] In an incomplete contracting framework, ex-ante it is not possible for the parties to commit to collaborate ex-post. See Hart and Moore (1999), Maskin and Tirole (1999), and Tirole (1999) for discussions of the incomplete contracting paradigm.

are more productive ($0 < \xi < 1$) or whether party B's investments are more productive ($\xi > 1$).

In a first-best world, the parties would collaborate ex-post and the total surplus would be given by $S^{FB} = a^{FB} + \xi b^{FB} - c(a^{FB}) - c(b^{FB})$, where the first-best investment levels are $a^{FB} = 1$ and $b^{FB} = \xi$.

In the incomplete contracting world, if the parties do not collaborate at date 2, their payoffs depend on the ownership structure as displayed in Table 1. First, consider A-ownership. Then in the case of disagreement party A (who owns the necessary assets) can produce the intermediate good without party B. Yet, in this case party A can make the profit $\lambda(a + \xi b)$ only, where $\lambda \in (0, 1]$, while party B makes zero profit. Note that party A can make use of party B's investments even when the parties do not collaborate, because the investments are in physical capital.[4] However, the investments may be relationship-specific; i.e., the returns of the investments may be strictly smaller in the absence of party B's human capital than in the case of collaboration. The degree of relationship specificity is given by $1 - \lambda$. The larger is λ, the smaller is the degree of relationship-specificity. In particular, if $\lambda = 1$, then there is no relationship-specificity at all.

Analogously, consider B-ownership. If there is disagreement, then party B (who owns the assets) can make the profit $\lambda(a + \xi b)$ by trading with someone else, while party A makes zero profit. Finally, consider joint ownership. In

[4] In contrast, if the investments were in *human capital*, under A-ownership the disagreement payoffs would be given by λa (party A) and 0 (party B), while under B-ownership they would be given by 0 (party A) and $\lambda \xi b$ (party B).

this case, each party has veto power over the use of the assets, so that both parties' disagreement payoffs are zero (cf. Hart, 1995).

	party A	party B
$o = A$	$\lambda(a + \xi b)$	0
$o = B$	0	$\lambda(a + \xi b)$
$o = J$	0	0

Table 1. The parties' disagreement payoffs at date 2.

We model the outcome of the date-2 negotiations using the Nash bargaining solution.[5] Hence, the parties will always collaborate and they agree on a transfer payment such that at date 2 each party gets its disagreement payoff plus half of the renegotiation surplus (i.e., the additional surplus that is generated by collaboration). Hence, if there is integration ($o = A$), then party A's date-2 payoff reads

$$u_A^A(a,b) = \lambda(a + \xi b) + \frac{1}{2}(1 - \lambda)[a + \xi b]$$

and party B's date-2 payoff is given by

$$u_B^A(a,b) = \frac{1}{2}(1 - \lambda)[a + \xi b].$$

If there is non-integration ($o = B$), then party A's date 2-payoff is

$$u_A^B(a,b) = \frac{1}{2}(1 - \lambda)[a + \xi b]$$

[5] See Muthoo (1999) for a comprehensive exposition of bargaining theory.

and party B's date-2 payoff reads

$$u_B^B(a,b) = \lambda(a+\xi b) + \frac{1}{2}(1-\lambda)[a+\xi b].$$

If there is joint ownership ($o = J$), then the parties' date-2 payoffs are given by

$$u_A^J(a,b) = \frac{1}{2}(a+\xi b)$$

and

$$u_B^J(a,b) = \frac{1}{2}(a+\xi b).$$

3 Results

Let us now analyze the parties' investment incentives. Given ownership structure $o \in \{A, B, J\}$, at date 1 party A chooses the investment level

$$a^o = \arg\max\{u_A^o(a,b) - c(a)\},$$

while B chooses the investment level

$$b^o = \arg\max\{u_B^o(a,b) - c(b)\}.$$

Hence, under A-ownership, the investment levels are $a^A = \frac{1}{2}(1+\lambda)$ and $b^A = \frac{1}{2}(1-\lambda)\xi$. Under B-ownership, the investment levels are given by $a^B = \frac{1}{2}(1-\lambda)$ and $b^B = \frac{1}{2}(1+\lambda)\xi$. Under joint ownership, the investment levels are $a^J = \frac{1}{2}$ and $b^J = \frac{1}{2}\xi$.

Lemma 1 *The investment levels can be ranked as follows:* $a^B < a^J < a^A \leq a^{FB}$ *and* $b^A < b^J < b^B \leq b^{FB}$*.*

At date 0, the parties agree on the ownership structure $o \in \{A, B, J\}$ that maximizes the total surplus $S^o = a^o + \xi b^o - c(a^o) - c(b^o)$. We can now state our main findings. Suppose first that the degree of relationship-specificity is exogenously given.

Proposition 1 *(i) Suppose that party A's investment is more productive ($\xi < 1$). If the productivity advantage is not too strong, then joint ownership is optimal, provided that the degree of relationship-specificity is sufficiently small; i.e., λ is larger than a critical value $\lambda_A \in (0, 1)$. Otherwise, A-ownership is optimal.*

(ii) Suppose that party B's investment is more productive ($\xi > 1$). If the productivity advantage is not too strong, then joint ownership is optimal, provided that the degree of relationship-specificity is sufficiently small; i.e., λ is larger than a critical value $\lambda_B \in (0, 1)$. Otherwise, B-ownership is optimal.

Proof. (i) It is straightforward to check that $S^A - S^B = \frac{1}{2}\lambda\left(1 - \xi^2\right) > 0$, since $\xi < 1$. Hence, A-ownership is better than B-ownership. Moreover, $S^J - S^A > 0$ whenever $\lambda > \lambda_A := 2(1 - \xi^2)/(1 + \xi^2)$. The critical value λ_A is smaller than 1 if party A's productivity advantage is not too strong (i.e., if $\xi > \sqrt{3}/3$).

(ii) Observe that $S^B - S^A = \frac{1}{2}\lambda\left(\xi^2 - 1\right) > 0$, since $\xi > 1$. Thus, B-ownership is better than A-ownership. Furthermore, $S^J - S^B > 0$ whenever $\lambda > \lambda_B := 2(\xi^2 - 1)/(1 + \xi^2)$. The critical value λ_B is smaller than 1 if party B's productivity advantage is not too strong (i.e., if $\xi < \sqrt{3}$). ■

Proposition 1 is in line with the examples in Hart and Moore (1990, pp. 1132–1133) and Hart (1995, pp. 68–69), according to which joint ownership can be optimal when investments are in physical capital.[6] However, the proposition also shows that joint ownership can be optimal only if the degree of relationship-specificity $1 - \lambda$ is sufficiently small.

Intuitively, joint ownership can be optimal because under sole ownership the non-owners' investment incentives are very small, as by investing the non-owner improves the owners' bargaining position. Yet, when the investments are very relationship-specific, then under sole ownership the non-owner's investment has only a relatively small impact on the owner's bargaining position, so that the party whose investments are more productive should be the owner (just as in the case of investments in human capital).

Suppose now that the degree of relationship-specificity can be endogenously chosen.

Proposition 2 *(i) Suppose that party A's investment is more productive ($\xi < 1$). If the degree of relationship-specificity $1 - \lambda$ can be freely chosen, then the parties agree on A-ownership and the optimal λ is strictly smaller than 1.*

(ii) Suppose that party B's investment is more productive ($\xi > 1$). If the degree of relationship-specificity $1 - \lambda$ can be freely chosen, then the parties agree on B-ownership and the optimal λ is strictly smaller than 1.

[6] Note that regardless of the degree of relationship-specificity, joint ownership would never be optimal if the investments were in *human capital* (cf. footnote 4). In this case, one can analogously show that $a^A = (1 + \lambda)/2$, $b^A = \xi/2$, $a^B = 1/2$, $b^B = (1 + \lambda)\xi/2$, $a^J = 1/2$, and $b^J = \xi/2$. Recall that $a^{FB} = 1$ and $b^{FB} = \xi$, so that there is never overinvestment. Since the total surplus is concave, it is larger under $o = A$ and $o = B$ than under $o = J$, since sole ownership increases one party's investment and does not change the other party's investment.

Proof. (i) Recall from the proof of Proposition 1(i) that S^A is larger than S^B when $\xi < 1$. It is easy to check that the total surplus S^A is maximal if $\lambda = (1-\xi^2)/(1+\xi^2) < 1$. Given this level of λ, joint ownership cannot be optimal, since $S^A - S^J = \left(1-\xi^2\right)^2/(8[1+\xi^2]) > 0$. Hence, A-ownership is optimal.

(ii) We already know that S^B is larger than S^A when $\xi > 1$. The total surplus S^B is maximal if $\lambda = (\xi^2-1)/(\xi^2+1) < 1$. Given this level of λ, joint ownership cannot be optimal, because $S^B - S^J = \left(\xi^2-1\right)^2/(8[\xi^2+1]) > 0$. Thus, B-ownership is optimal. ■

Proposition 2 shows that with endogenous relationship-specificity, if a party's investments are more productive, then ownership by this party is always optimal, even when investments are in physical capital. Moreover, the parties agree on a strictly positive degree of relationship-specificity ($1-\lambda > 0$). In contrast, if the investments were in human capital, as is typically assumed in the literature on the property rights approach, the parties would clearly prefer to remove any relationship-specificity (i.e., they would choose $1-\lambda = 0$).[7]

Intuitively, suppose that party A's investments are more productive. We know that joint ownership may be better than A-ownership since party B's incentives are weaker under A-ownership (as party B improves party A's bargaining position by investing). Yet, compared to joint ownership, increasing the degree of relationship-specificity under A-ownership is a better way to mit-

[7] If the investments were in *human capital* (cf. footnote 4), then both S^A and S^B would be maximal when $\lambda = 1$, because the owner's investment incentives are increasing in λ, while the non-owners incentives are independent of λ (see footnote 6).

igates the impact of party B's investment on party A's bargaining position, since the optimal choice of λ reduces party A's incentives less than the choice of joint ownership.

As an illustration, Figure 1 depicts a case in which party A's investments are more productive ($\lambda = 0.7$). Note that if the degree of relationship-specificity is exogenously given, than joint ownership is optimal only if $\lambda > 0.685$. If the degree of relationship-specificity can be endogenously chosen, the parties always agree on A-ownership and choose $\lambda = 0.342$.

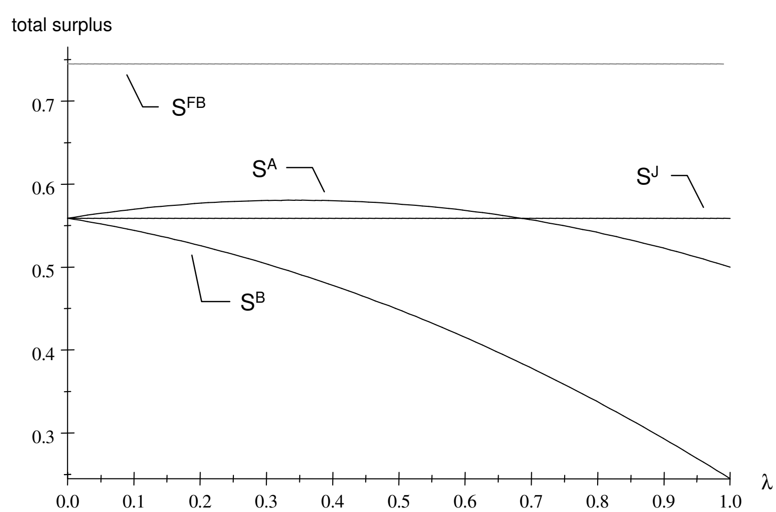

Figure 1. The total surplus levels as functions of λ, when party A's investment is more productive ($\xi = 0.7$).

4 Conclusion

We have reconsidered the property rights approach to the theory of the firm based on incomplete contracts. Taken together, our results show that even when investments are in physical capital, joint ownership may well be suboptimal. In particular, joint ownership is generically suboptimal if the degree of relationship-specificity can be freely chosen. Hence, when we want to explain joint ownership arrangements which are prevalent in the real world, it seems to be important to also consider potential reasons different from investments in physical capital.[8]

[8] In particular, joint ownership can be optimal when the bargaining outcomes are determined by the outside-option principle (see Chiu, 1998, and De Meza and Lockwood, 1998) or when ex-post disagreement may lead to costly conflicts (Annen, 2009). Moreover, it has been shown that joint ownership can be optimal in repeated game settings (Halonen, 2002) or in the presence of asymmetric information (Schmitz, 2006, 2008).

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