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Abstract

In the Grossman-Hart-Moore property rights approach to the theory of the firm, it is usually assumed that information is symmetric. Ownership matters for investment incentives, provided that investments are *partly* relationship-specific. We study the case of *completely* relationship-specific investments (i.e., the disagreement payoffs do not depend on the investments). It turns out that if there is asymmetric information, then ownership matters for investment incentives and for the expected total surplus. Specifically, giving ownership to party B can be optimal, even when only party A has to make an investment decision and even when the owner's expected disagreement payoff is larger under A-ownership.

Keywords: Property rights; relationship specificity; investment incentives; private information; incomplete contracts

JEL classification: D23; D82; D86; L23; L24

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1 Introduction

It is by now widely appreciated that the property rights approach to the theory of the firm and the underlying incomplete contracts paradigm, which were developed by Grossman and Hart (1986), Hart and Moore (1990), and Hart (1995), are among the most important advances in microeconomics in the past three decades.[1]

Consider two parties, A and B. According to the property rights approach, ownership of a physical asset can foster a party's investment incentives. When contracts are incomplete, the parties will divide the investments' returns in future negotiations. Ownership matters, because it improves a party's disagreement payoff (i.e., the payoff that it could realize on its own) and hence its future bargaining position. However, a crucial assumption of the property rights approach is that investments are *partly* relationship-specific. The positive effect that investments have on the surplus that the parties can generate together is assumed to be larger than the effect that the investments have on the disagreement payoffs; yet, the latter effect must not be zero.

In contrast, in the present paper we focus on *completely* relationship-specific investments; i.e., the investments' returns can be realized only within the relationship between A and B. Since the investments do not affect the disagreement payoffs, ownership would not matter in the standard property rights setup, where information is assumed to be symmetric.

However, in contrast to the standard model, we assume that after the investment stage the owner of the asset privately learns his disagreement payoff; i.e., we allow for *asymmetric information*.[2] We show that in this case owner-

[1] The incomplete contracts approach is the centerpiece of Oliver Hart's work, who has recently been awarded the Nobel Prize in Economic Sciences together with Bengt Holmström (cf. Nobel Prize Committee, 2016). Andrei Shleifer has emphasized that the "Grossman-Hart incomplete contracts approach represents perhaps the most influential advance in economic theory in the last thirty years" (see the back cover of Aghion et al., 2016).

[2] Holmström (1999) already pointed out that the usual assumption according to which both parties observe the disagreement payoffs deserves more scrutiny. The fact that in the standard model of the property rights approach bargaining is always ex post efficient has also been criticized by Williamson (2002). In the present paper, ex post inefficiencies may occur since bargaining takes place under asymmetric information, which moves the property rights approach closer to transaction cost economics. For a model of ex post haggling, see also the recent work by Mori (2017).

ship matters, even when investments are completely relationship-specific. In particular, we focus on a model in which only party A has an investment decision. We show that nevertheless there are circumstances under which the parties strictly prefer B-ownership, which may be the case even when the expected disagreement payoff is larger under A-ownership.

Related literature. To my knowledge, completely relationship-specific investments have not yet been investigated in the literature on the property rights approach to the theory of the firm. There are only a few papers that study the role of asymmetric information in the property rights approach.[3] In Schmitz (2006), a party may gather private information about the fraction of the collaboration surplus that it can realize on its own; hence, in contrast to the present paper the disagreement payoff depends on the investment. In a recent contribution by Su (2017), there is asymmetric information already before the ownership structure is chosen, while in Goldlücke and Schmitz (2014) asymmetric information is learnt before the investment stage but after the allocation of ownership. In contrast, in the present paper the owner learns his private information after the investment stage.[4]

2 The model

Consider two risk-neutral parties, A and B. At some future date $t = 2$, the parties can by collaboration generate a surplus $V + i \geq 0$. For instance, party A may be the seller of an intermediate good that can be used by party B in order to produce a final good. Producing the intermediate good requires access to a unique physical asset.[5] At date $t = 0$, the parties agree on an ownership structure $o \in \{A, B\}$. If there is integration ($o = A$), then party A controls the asset, so it can use the asset without party B's consent. If there

[3] In addition, there are some papers that analyze how ownership rights should be allocated in adverse selection models building on Myerson and Satterthwaite (1983); see e.g. Samuelson (1985), McKelvey and Page (2002), and Matouschek (2004). Yet, these papers do not consider investments and hence are less related to the property rights approach developed by Grossman and Hart (1986) and Hart and Moore (1990).

[4] Note that there are also several papers on asymmetric information in hold-up problems that do not study the role of property rights, see Goltsman (2011) and the literature discussed there.

[5] The asset may be a specific machine or a building (cf. Hart, 1995). For simplicity, we do not model any assets that might be needed to produce the final good.

is non-integration ($o = B$), then party B has control over the asset. At date $t = 1$, party A can make an observable but non-contractible investment $i \geq 0$ in its human capital; the investment costs are given by $\frac{1}{2}i^2$. Finally, at date $t = 2$ the parties bargain over whether or not to cooperate.

Following the incomplete contracting literature, at date $t = 0$ the parties agree on an ownership structure that maximizes their expected total surplus.[6] The ownership structure determines the parties' date-2 disagreement payoffs (i.e., their payoffs when they do not cooperate). Departing from the standard property rights model, we assume that the investment is *completely* relationship-specific; i.e., the investment is lost when the parties fail to collaborate at date $t = 2$.

Suppose first that party A is the owner of the asset ($o = A$). If the parties do not collaborate at date $t = 2$, party A gets only $v_A \in \{0, V\}$, where $p_A = \Pr\{v_A = V\} \in (0, 1)$, while party B gets zero (since it has no access to the essential asset). Hence, party A might be able to produce a final good without party B's human capital, but it is ex ante uncertain whether or not it can do so.

Next, suppose that party B is the owner ($o = B$). Then at date $t = 2$ party A's disagreement payoff is zero, since it cannot access the asset that is essential to produce the intermediate good. Party B's disagreement payoff is $v_B \in \{0, V\}$, where $p_B = \Pr\{v_B = V\} \in (0, 1)$. Thus, party B might be able to produce an intermediate good without party A, but it is initially uncertain whether or not party B can do so.

Under symmetric information, according to the Coase theorem the parties would always agree to collaborate at date $t = 2$, which is ex post efficient. Yet, in contrast to the standard property rights model, we assume that there may be *asymmetric information*. In particular, v_A and v_B are random variables, which are realized at date $t = 1.5$. When there is asymmetric information, then at date $t = 1.5$ only party A learns the realization of v_A under A-ownership, while only party B learns the realization of v_B under B-ownership.[7]

We consider the following date-2 bargaining game. With probability $\pi \in$

[6] See Hart (1995). The parties can divide the expected total surplus with a suitable lump-sum payment. Apart from that, no other contractual arrangements can be made at date $t = 0$.

[7] Apart from the realizations of the random variables, all elements of the model are common knowledge.

$(0,1)$ party A can make a take-it-or-leave-it offer to party B, while otherwise party B can make a take-it-or-leave-it offer to party A.[8]

The first-best solution. In a first-best world, at date $t = 2$ the parties always collaborate. Moreover, at date $t = 1$ party A chooses the investment level $i^{FB} = 1$, which maximizes the total surplus $V + i - \frac{1}{2}i^2$.

3 Symmetric information

Suppose the parties are symmetrically (un)informed; i.e., either both parties learn the realization of the owner's disagreement payoff at date $t = 1.5$, or no one does.

Consider A-ownership. At date $t = 2$, with probability π party A can make a take-it-or-leave it offer. Party A then offers to collaborate and to keep the whole date-2 surplus $V + i$, which will be accepted by party B since its disagreement payoff is zero. When party B can make the offer, it proposes to collaborate if party A accepts to get v_A (if both parties know the realization of v_A) or $p_A V$ (if no party knows the realization of v_A). The offer will be accepted by party A, because it gets its (expected) disagreement payoff. In any case, party A's expected date-1 payoff reads

$$\pi(V + i) + (1 - \pi)p_A V - \frac{1}{2}i^2.$$

Thus, party A will invest $i^A = \pi$ and the total surplus is

$$S^A = V + \pi - \frac{1}{2}\pi^2.$$

Under B-ownership, party A's expected date-2 payoff is $V + i - p_B V$ when party A can make the offer, while it is 0 otherwise. Hence, party A's expected date-1 payoff reads

$$\pi((1 - p_B)V + i) - \frac{1}{2}i^2.$$

Therefore, party A will invest $i^B = \pi$ and the expected total surplus is

$$S^B = V + \pi - \frac{1}{2}\pi^2.$$

[8] This simple bargaining game has often been used in the related literature, see e.g. Hart and Moore (1999, p. 135). In fact, it is the simplest non-cooperative bargaining game consistent with the standard property rights model. To see this, note that if the parties are symmetrically informed, the game leads to the generalized Nash bargaining solution, where π is party A's bargaining power.

Proposition 1 *If the parties are symmetrically (un)informed, then party A invests $i^o = \pi$ and the expected total surplus is $S^o = V + \pi - \frac{1}{2}\pi^2$, regardless of the ownership structure $o \in \{A, B\}$.*

Under symmetric information ownership does not matter, since the investment is completely relationship-specific.[9]

4 Asymmetric information

Suppose now only the party who owns the asset learns the realization of its disagreement payoff at date $t = 1.5$.

Consider A-ownership. At date $t = 2$, party A can make the take-it-or-leave it offer with probability π. Party A then proposes to cooperate and to keep the total date-2 surplus $V + i$, which will be accepted by party B, whose disagreement payoff is zero. When party B can make the offer, it proposes to collaborate if party A agrees to get α_A, which party A accepts whenever $\alpha_A \geq v_A$. Maximizing its expected payoff, party B sets

$$\alpha_A = \arg\max(V + i - \alpha) \Pr\{v_A \leq \alpha\}.$$

Observe that α_A will be either 0 or V. Specifically, party B prefers $\alpha_A = V$ whenever the condition $i \geq (1 - p_A)(V + i)$, or equivalently $i \geq \frac{1-p_A}{p_A}V$, is satisfied.

If $i \geq \frac{1-p_A}{p_A}V$, then at date $t = 1$ player A's expected payoff is

$$u_A(i) = \pi(V + i) + (1 - \pi)V - \frac{1}{2}i^2$$

and player B's expected payoff is $(1 - \pi)i$. If $i < \frac{1-p_A}{p_A}V$, player A's expected payoff reads

$$w_A(i) = \pi(V + i) + (1 - \pi)p_A V - \frac{1}{2}i^2$$

and player B's expected payoff is $(1-\pi)(1-p_A)(V+i)$. Observe that $u_A(i) > w_A(i)$. Note that both $u_A(i)$ and $w_A(i)$ are maximized by $i = \pi$, so party A will invest either $i = \pi$ or $i = \frac{1-p_A}{p_A}V$. When $\pi \geq \frac{1-p_A}{p_A}V$, or equivalently $p_A \geq \frac{V}{V+\pi}$, it is optimal for party A to invest $\tilde{i}^A = \pi$. Now consider the case

[9] Moreover, note that (i) there is never overinvestment compared to the first-best benchmark and (ii) when party A's bargaining power π goes to one, the first-best outcome will be achieved.

$p_A < \frac{V}{V+\pi}$. In this case, there must exist a critical value $\tilde{p}_A \in (0, \frac{V}{V+\pi})$ such that it is optimal for party A to invest $\tilde{\imath}^A = \pi$ for $p_A < \tilde{p}_A$ and to invest $\tilde{\imath}^A = \frac{1-p_A}{p_A}V$ for $p_A \geq \tilde{p}_A$.[10]

Hence, the expected total surplus under A-ownership is

$$\tilde{S}^A = \begin{cases} V + (1-(1-\pi)p_A)\,\pi - \frac{1}{2}\pi^2 & if \;\; p_A < \tilde{p}_A, \\ V + \frac{1-p_A}{p_A}V - \frac{1}{2}(\frac{1-p_A}{p_A}V)^2 & if \;\; \tilde{p}_A \leq p_A < \frac{V}{V+\pi}, \\ V + \pi - \frac{1}{2}\pi^2 & if \;\; \frac{V}{V+\pi} \leq p_A. \end{cases}$$

Next, consider B-ownership. At date $t = 2$, party A can make the offer with probability π. In this case, party A offers to collaborate if party B agrees to get β_B, which party B accepts whenever $\beta_B \geq v_B$. To maximize its expected payoff, party A sets

$$\beta_B = \arg\max (V + i - \beta)\Pr\{v_B \leq \beta\}.$$

Thus, party A sets $\beta_B = V$ whenever the condition $i \geq (1-p_B)(V+i)$ is satisfied, which can be rewritten as $i \geq \frac{1-p_B}{p_B}V$. Otherwise, party A sets $\beta_B = 0$. When party B can make the offer, it proposes to cooperate and to keep the total date-2 surplus $V + i$, which will be accepted by party A, since its disagreement payoff is zero.

At date $t = 1$, player A's expected payoff is

$$\pi \max\{i, (1-p_B)(V+i)\} - \frac{1}{2}i^2.$$

Party B's expected payoff is $\pi V + (1-\pi)(V+i)$ if $i \geq \frac{1-p_B}{p_B}V$, and $\pi p_B V + (1-\pi)(V+i)$ otherwise. Let us define a critical value

$$\tilde{p}_B = V/\pi - (1 + V^2/\pi^2)^{1/2} + 1.$$

Maximizing its expected payoff, party A invests $\tilde{\imath}^B = \pi$ if $p_B \geq \tilde{p}_B$, and it invests $\tilde{\imath}^B = (1-p_B)\pi$ otherwise.[11]

[10] To see this, note that $f(p) := u_A(\frac{1-p_A}{p_A}V) - w_A(\pi)$ is strictly negative for p sufficiently small, $f(\frac{V}{V+\pi}) > 0$, and $f(p)$ is strictly concave for $p_A \in (0, \frac{V}{V+\pi})$.

[11] To see this, observe that if $\pi < \frac{1-p_B}{p_B}V$, party A invests $i = (1-p_B)\pi$ and sets $\beta_B = 0$. Now suppose $\pi \geq \frac{1-p_B}{p_B}V$. If party A invests $i = \pi$ and sets $\beta_B = V$, its expected payoff is $\frac{1}{2}\pi^2$. Yet, if $(1-p_B)\pi < \frac{1-p_B}{p_B}V$, it might also invest $(1-p_B)\pi$ and set $\beta_B = 0$, so its expected payoff would be $\pi(1-p_B)(V+(1-p_B)\pi) - \frac{1}{2}(1-p_B)^2\pi^2$. The latter decision is more profitable if $p_B < \tilde{p}_B$. Note that this condition can be satisfied only if $(1-p_B)\pi < \frac{1-p_B}{p_B}V$, and the condition is always satisfied if $\pi < \frac{1-p_B}{p_B}V$.

As a consequence, the expected total surplus under B-ownership reads

$$\tilde{S}^B = \begin{cases} V + (1 - \pi p_B)\,(1 - p_B)\,\pi - \frac{1}{2}(1 - p_B)^2\pi^2 & if \quad p_B < \tilde{p}_B, \\ V + \pi - \frac{1}{2}\pi^2 & if \quad p_B \geq \tilde{p}_B. \end{cases}$$

Proposition 2 *Consider the case of asymmetric information. Under A-ownership, there exists a critical value $\tilde{p}_A \in (0, \frac{V}{V+\pi})$ such that party A invests $\tilde{\imath}^A = \pi$ if $p_A < \tilde{p}_A$ or if $p_A \geq \frac{V}{V+\pi}$, while it invests $\tilde{\imath}^A = \frac{1-p_A}{p_A}V > \pi$ otherwise. The expected total surplus is given by $\tilde{S}^A$. Under B-ownership, party A invests $\tilde{\imath}^B = \pi$ if $p_B \geq \tilde{p}_B$, while it invests $\tilde{\imath}^B = (1 - p_B)\pi < \pi$ otherwise. The expected total surplus is given by $\tilde{S}^B$.*

Thus, under asymmetric information ownership matters, even though the investment is completely relationship-specific.[12] Our findings are illustrated in Figures 1, 2, and 3, where $V = 1$ and $\pi = 1/2$.

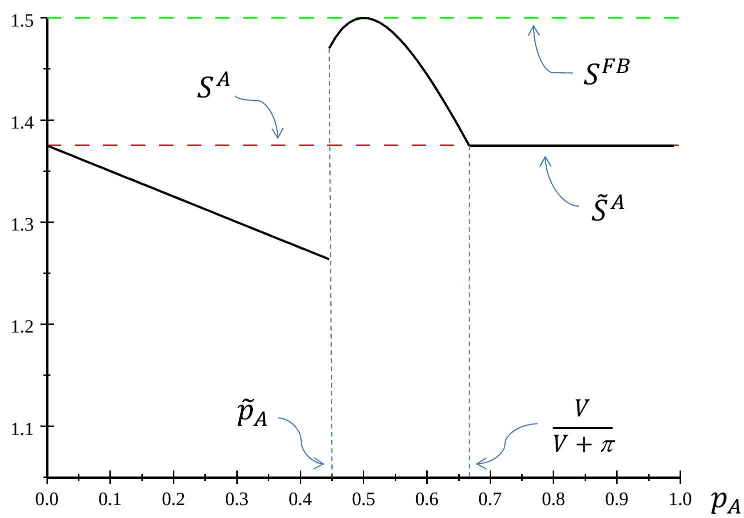

Figure 1. The expected total surplus under A-ownership given asymmetric information ($\tilde{S}^A$), compared to the symmetric-information (S^A) and first-best (S^{FB}) benchmarks.

[12]Moreover, note that (i) under A-ownership there can be overinvestment compared to the first-best benchmark and (ii) when party A's bargaining power π goes to one, the first-best result is attained under A-ownership, while under B-ownership the first-best outcome is achieved only if $p_B \geq V - (1 + V^2)^{1/2} + 1$.

Figure 1 shows the expected total surplus under A-ownership. If p_A is smaller than $\tilde{p}_A$, the investment level is the same as under symmetric information ($\tilde{\imath}^A = \pi$). Yet, when party B makes the offer, party A will reject it with probability p_A, so there is an ex post inefficiency which becomes more severe when p_A becomes larger. If p_A lies between $\tilde{p}_A$ and $\frac{V}{V+\pi}$, party A invests more than it would do under symmetric information ($\tilde{\imath}^A = \frac{1-p_A}{p_A} V > \pi$) in order to get a better offer from party B. In this case, ex post efficiency will always be attained.[13] If p_A is larger than $\frac{V}{V+\pi}$, party A makes the same investment as under symmetric information and ex post efficiency is achieved.

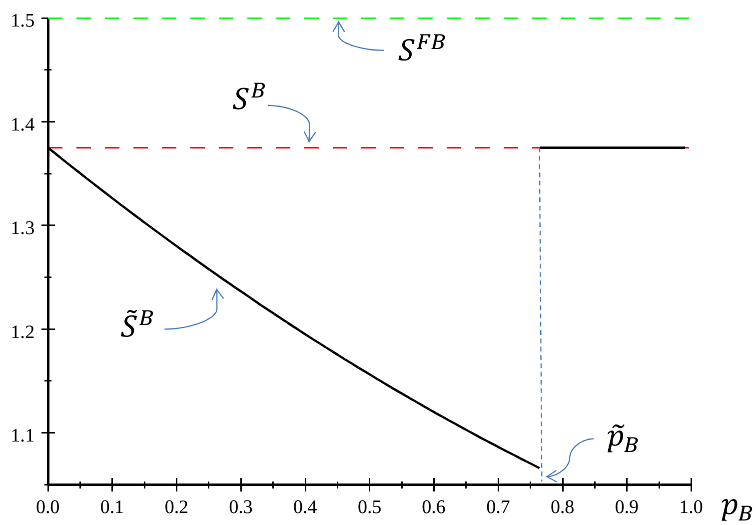

Figure 2. The expected total surplus under B-ownership given asymmetric information ($\tilde{S}^B$), compared to the symmetric-information (S^B) and first-best (S^{FB}) benchmarks.

Figure 2 displays the expected total surplus under B-ownership. If p_B is smaller than $\tilde{p}_B$, party A invests less than it would do under symmetric information ($\tilde{\imath}^B = (1 - p_B)\pi < \pi$) and there is an ex post inefficiency with

[13] Observe that there is overinvestment with regard to the first-best benchmark ($i^{FB} = 1$) when p_A lies between $\tilde{p}_A$ and 1/2, while there is underinvestment when p_A is larger than 1/2.

probability p_B. If p_B is larger than $\tilde{p}_B$, party A chooses the same investment level as under symmetric information ($\tilde{\imath}^B = \pi$) and ex post efficiency is attained.

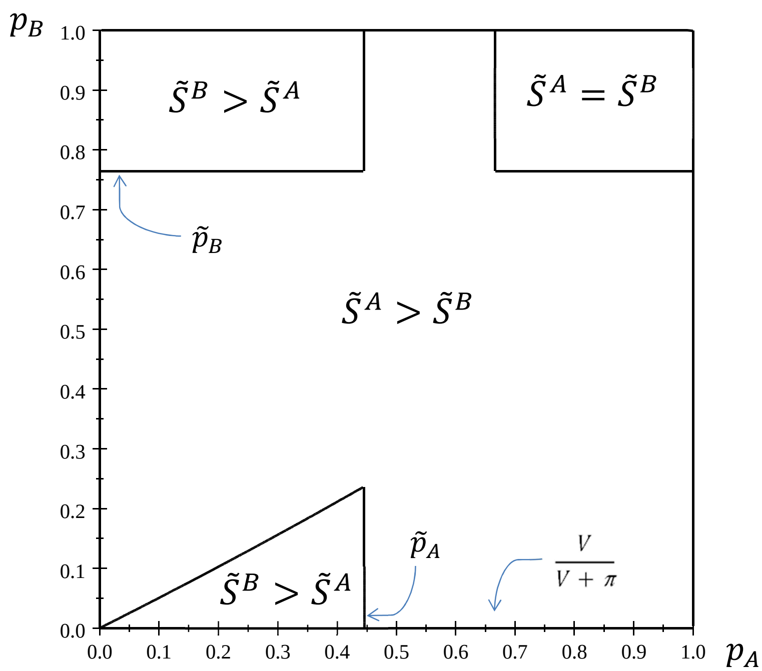

Figure 3. The optimal ownership structure given asymmetric information.

Figure 3 depicts the optimal ownership structure depending on p_A and p_B. Recall that under symmetric information, the parties would always be indifferent between the two ownership structures. Under asymmetric information, this is the case if p_A is larger than $\frac{V}{V+\pi}$ and p_B is larger than $\tilde{p}_B$. However, B-ownership is strictly better than A-ownership if p_A is smaller than $\tilde{p}_A$ and p_B is larger than $\tilde{p}_B$. Moreover, B-ownership is optimal if p_A is smaller than $\tilde{p}_A$ and p_B is sufficiently small.[14] In all other parameter constellations, A-ownership is optimal.

[14] Note that in this parameter constellation, the investment level is smaller under B-ownership ($\tilde{\imath}^B = (1 - p_B)\pi$) than under A-ownership ($\tilde{\imath}^A = \pi$), so B-ownership can be optimal only if an ex post inefficiency is sufficiently more likely under A-ownership. This observation explains why B-ownership can be optimal even when $p_A > p_B$, i.e. when the expected disagreement payoff is larger under A-ownership.

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