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Abstract

In the Grossman-Hart-Moore property rights theory, there are no frictions ex post (i.e., after non-contractible investments have been sunk). In contrast, in transaction cost economics ex-post frictions play a central role. In this note, we bring the property rights theory closer to transaction cost economics by allowing for ex-post moral hazard. As a consequence, central conclusions of the Grossman-Hart-Moore theory may be overturned. In particular, even though only party A has to make an investment decision, B-ownership can yield higher investment incentives. Moreover, ownership matters even when investments are *fully* relationship-specific (i.e., when they have no impact on the parties' disagreement payoffs).

Keywords: Incomplete contracts; ownership rights; investment incentives; relationship specificity; moral hazard

JEL classification: D23; D86; G34; L23; L24

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1 Introduction

Why do some transactions take place within firms, while other transactions take place in the market? The leading answer to this question in modern economic theory builds on the idea that contracts are incomplete, as formalized by Grossman and Hart (1986), Hart and Moore (1990), and Hart (1995) in their seminal property rights approach.[1] When contracts are incomplete, ownership rights matter in future negotiations, because they determine what will happen in the case of disagreement. Anticipating the outcome of tomorrow's negotiations, a party that will be in a better bargaining position has stronger incentives to make non-contractible investments today.

A central conclusion of the theory is that if only party A has to make an investment decision, then ownership by party B cannot yield higher investment incentives than ownership by party A. Moreover, ownership matters only if investments have an influence on the parties' disagreement payoffs. Thus, if investments are *fully* relationship-specific (i.e., they are worthless when the parties do not collaborate), the ownership structure is irrelevant for the investment incentives.

The property rights theory has been criticized because there are no ex-post frictions, which play a central role in traditional transaction cost economics. Specifically, Williamson (2002, p. 188) has pointed out that the assumption that there are no ex-post frictions is "deeply problematic" and that it is the "most consequential difference" (Williamson, 2000, p. 605) between the property rights theory and transaction cost economics.

In the present paper, we bring the property rights theory closer to transaction cost economics by introducing an ex-post moral hazard problem. It turns out that central conclusions of the property rights theory can be overturned. Ownership by a non-investing party can lead to higher invest-

[1] Indeed, according to Andrei Shleifer the "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).

ment incentives, and ownership matters even when investments are fully relationship-specific.

Related literature. While the present paper adds a moral hazard problem to the Grossman-Hart-Moore setup, other papers have added an adverse selection problem. For instance, in Schmitz (2006, 2017) a party learns private information about its disagreement payoff after the investment stage, while in Su (2017) there is asymmetric information at the outset already.

In the literature investigating contractual solutions to hold-up problems, Goltsman (2011) studies the role of asymmetric information, while Schmitz (2012) studies the role of moral hazard. These papers do not explore the implications of different ownership arrangements.

The present paper is complementary to Mori (2018), who also combines the property rights theory with transaction cost economics. Mori (2018) studies an incomplete contracting setup with sequential investments in order to model a trade-off between ex-ante investments and ex-post adaptations. Moral hazard does not play a role in his model.

The source of the ex post frictions in our setup is a moral hazard problem with limited liability.[2] See Innes (1990) and Pitchford (1998) for early papers on moral hazard with limited liability.[3] In contrast to the present paper, in this literature complete contracting models are studied.

2 The model

There are two risk-neutral parties, A and B. For instance, party A might have the human capital to conduct research in the field of biotechnology, while party B might be a large pharmaceutical company. Following Aghion and Tirole (1994) and Tirole (1999), suppose that party A has no wealth and is protected by limited liability. At date 0, an ownership structure $o \in$

[2]For a different formalization of ex-post haggling, see the recent work by Mori (2017).

[3]For more recent papers on moral hazard problems with limited liability, see e.g. Kräkel and Schöttner (2016), Pi (2018), or At et al. (2019).

$\{A, B\}$ is fixed. If $o = A$, then party A controls the relevant physical assets (non-integration). If $o = B$, then party B has control over the relevant assets (integration). Following the Grossman-Hart-Moore approach, the parties cannot yet write an incentive contract at date 0.

At date 1, party A invests effort $i \in [0, 1]$ in basic research activities. Party A's disutility of effort is given by $\frac{1}{2}i^2$. At date 2, the interim outcome $\omega \in \{L, H\}$ is realized, where the success probability is given by $\Pr\{\omega = H|i\} = i$. The interim outcome determines the expected revenue that can be generated if a marketable innovation will be developed.

At date 3, the ex-post stage is reached and the parties can negotiate a contract. At date 4, party A exerts effort $e \in [0, 1]$ in order to develop a marketable innovation, where the disutility of effort is given by $\frac{1}{2}e^2$. At date 5, the final outcome $\rho \in \{0, 1\}$ is realized, where the success probability is $\Pr\{\rho = 1|e\} = e$.

When at date 3 the parties agree to collaborate, then the revenue that they can generate together at date 5 is given by ρR_ω, where $0 < R_L < R_H < 1$. When at date 3 the parties do not reach an agreement to collaborate, then in line with the Grossman-Hart-Moore theory, the parties' disagreement payoffs depend on the ownership structure.

Suppose first that $o = A$ (non-integration). In this case, the revenue that party A can generate without party B's collaboration at date 5 is given by ρr_ω, where $r_H < R_H$ and $r_L \leq R_L$. Hence, when party A owns the relevant assets, it can commercialize the innovation without party B's human capital, but the revenues will be smaller. We suppose $0 \leq r_H - r_L < R_H - R_L$, so the investment i is relationship-specific; i.e., its effect is larger when the two parties will collaborate.[4] In order to keep the exposition short, we will assume that $r_H \geq \frac{1}{2}R_H$ and $r_L \geq \frac{1}{2}R_L$.[5] Since party B cannot commercialize

[4]Note that if $r_H = r_L$, the investment i is *fully* relationship-specific, which means that it has no effect outside of the relationship.

[5]If the assumption is dropped, the analysis can be performed in analogy to what follows, but one has to make some additional case distinctions in Section 4. For brevity,

the innovation without party A, party B's disagreement payoff is zero.

Now suppose that $o = B$ (integration). In this case, both parties' disagreement payoffs are zero. Since party A does not have access to the relevant assets, it cannot commercialize the innovation on its own. Party B cannot make a positive profit, because the human capital of party A is indispensable.

Following the Grossman-Hart-Moore property rights theory, we assume that the parties are symmetrically informed at date 3.[6] In line with the Coase Theorem, the parties will always agree to collaborate, which is ex-post efficient (since $R_\omega \geq r_\omega$). Nevertheless, the disagreement payoffs (and hence the ownership structure) are important, because they determine the threatpoint in the date-3 negotiations. Specifically, we assume that at date 3, with probability $\alpha \in (0, 1)$ 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.[7]

We will consider two different scenarios. In scenario I, party A's date-4 effort e is verifiable; i.e., there is no ex-post moral hazard, as in the standard Grossman-Hart-Moore theory. In scenario II, only the final outcome ρ is verifiable, whereas party A's date-4 effort e is a hidden action; i.e., there is an ex-post moral hazard problem.

The first-best solution. In a first-best world, the parties will always collaborate. At date 4, the effort level

$$\begin{aligned} e^{FB}(\omega) &= \arg\max eR_\omega - \frac{1}{2}e^2 \\ &= R_\omega \end{aligned}$$

is exerted, and the expected date-3 surplus is $\frac{1}{2}R_\omega^2$. At date 1, the investment

we focus on the most interesting case.

[6]Hence, the interim outcome ω is observable but not verifiable. Note that it makes no difference whether the non-contractible investment level i is observable or unobservable.

[7]This simple bargaining game has often been used in the related literature, see e.g. Hart and Moore (1999, p. 135).

level

$$
\begin{aligned}
i^{FB} &= \arg\max i\frac{1}{2}R_H^2 + (1-i)\frac{1}{2}R_L^2 - \frac{1}{2}i^2 \\
&= \frac{1}{2}(R_H^2 - R_L^2)
\end{aligned}
$$

is chosen.[8]

3 Scenario I: No moral hazard

Suppose the date-4 effort e is verifiable. Consider first integration ($o = B$), so both parties' disagreement payoffs are zero. At date 3, the parties will agree on $e = e^{FB}(\omega)$. The party that can make the date-3 offer will extract the expected date-3 total surplus $\frac{1}{2}R_\omega^2$. Hence, at date 1 party A will invest

$$
\begin{aligned}
i^{B} &= \arg\max i\alpha\frac{1}{2}R_H^2 + (1-i)\alpha\frac{1}{2}R_L^2 - \frac{1}{2}i^2 \\
&= \alpha\frac{1}{2}(R_H^2 - R_L^2).
\end{aligned}
$$

Next, consider non–integration ($o = A$). If the parties do not collaborate, at date 4 party A will exert effort

$$
\begin{aligned}
e(\omega) &= \arg\max er_\omega - \frac{1}{2}e^2 \\
&= r_\omega,
\end{aligned}
$$

so its disagreement payoff is $\frac{1}{2}r_\omega^2$. Recall that party B's disagreement payoff is zero. When party A can make the offer at date 3, it will offer to set $e = e^{FB}(\omega)$ and extract the expected date-3 total surplus $\frac{1}{2}R_\omega^2$. When party B can make the offer, it will also propose $e = e^{FB}(\omega)$ and it will leave party A its disagreement payoff $\frac{1}{2}r_\omega^2$. Hence, at date 1 party A will invest

$$
\begin{aligned}
i^{A} &= \arg\max i\frac{1}{2}[\alpha R_H^2 + (1-\alpha)r_H^2] + (1-i)\frac{1}{2}[\alpha R_L^2 + (1-\alpha)r_L^2] - \frac{1}{2}i^2 \\
&= \alpha\frac{1}{2}(R_H^2 - R_L^2) + (1-\alpha)\frac{1}{2}(r_H^2 - r_L^2).
\end{aligned}
$$

[8] Note that the revenue r_ω and the bargaining power α do not play a role in a first-best world.

Observe that $i^B \leq i^A < i^{FB}$.[9]

The following result summarizes the main insights that follow in scenario I.

Proposition 1 *Suppose there is no ex-post moral hazard.*

(i) If $r_H > r_L$, the date-1 investment is strictly larger under $o = A$ than under $o = B$.

(ii) If $r_H = r_L$, so the investment i is fully relationship-specific, ownership does not matter (i.e., $i^A = i^B$).

These findings are in line with the standard Grossman-Hart-Moore theory. In particular, since party A is the only party that has to make an investment decision, A-ownership leady to higher investment incentives than B-ownership, provided that the investment is not fully relationship-specific. In the latter case, ownership does not matter.

4 Scenario II: Moral hazard

Now suppose the date-4 effort e is a hidden action. Consider first integration ($o = B$), so both parties' disagreement payoffs are zero. When party A can make the offer at date 3, it will propose a contract according to which at date 5 party A will get ρR_ω, so party A will exert effort $e^{FB}(\omega) = R_\omega$ and its expected date-3 payoff is $\frac{1}{2}R_\omega^2$. When party B can make the offer, it will propose a contract which says that at date 5 party A will get a payment $t_\rho \geq 0$ (and party B will get $\rho R_\omega - t_\rho$). It is straightforward to verify that party B will set $t_0 = 0$ and $t_1 < 1$. Party A will then choose the effort level that maximizes $et_1 - \frac{1}{2}e^2$, so $e = t_1$. Party B hence proposes a contract that maximizes $t_1(R_\omega - t_1)$. Thus, $t_1 = \frac{1}{2}R_\omega$ and party A's expected date-3

[9] Note that our assumptions imply that $r_H^2 - r_L^2 = (r_H - r_L)(r_H + r_L)$ is strictly smaller than $R_H^2 - R_L^2 = (R_H - R_L)(R_H + R_L)$.

payoff is $\frac{1}{8}R_\omega^2$. As a consequence, at date 1 party A will invest

$$\begin{aligned}\tilde{\imath}^B &= \arg\max i[\alpha\frac{1}{2}R_H^2 + (1-\alpha)\frac{1}{8}R_H^2] + (1-i)[\alpha\frac{1}{2}R_L^2 + (1-\alpha)\frac{1}{8}R_L^2] - \frac{1}{2}i^2 \\ &= (1+3\alpha)\frac{1}{8}[R_H^2 - R_L^2].\end{aligned}$$

Now consider non-integration ($o = A$). Recall that if the parties do not collaborate, at date 4 party A will exert effort $e(\omega) = r_\omega$, so at date 3 its disagreement payoff is $\frac{1}{2}r_\omega^2$, while party B's disagreement payoff is zero. When party A can make the offer at date 3, it will extract the date-5 return ρR_ω, so party A will choose $e^{FB}(\omega) = R_\omega$ and its expected date-3 payoff is $\frac{1}{2}R_\omega^2$. Now suppose party B can make the offer. Party B will design a contract according to which at date 5 party A will get a payment $t_\rho \geq 0$. It is again straightforward to check that party B will set $t_0 = 0$ and $t_1 < 1$. Party A will accept the offer and exert effort $e = t_1$ if $\frac{1}{2}t_1^2 \geq \frac{1}{2}r_\omega^2$. Thus, party B maximizes $t_1(R_\omega - t_1)$ subject to $t_1 \geq r_\omega$. As a result $t_1 = r_\omega$, since $r_\omega \geq \frac{1}{2}R_\omega$.[10] Therefore, at date 1 party A will choose the investment level

$$\begin{aligned}\tilde{\imath}^A &= \arg\max i\frac{1}{2}[\alpha R_H^2 + (1-\alpha)r_H^2] + (1-i)\frac{1}{2}[\alpha R_L^2 + (1-\alpha)r_L^2] - \frac{1}{2}i^2 \\ &= \alpha\frac{1}{2}(R_H^2 - R_L^2) + (1-\alpha)\frac{1}{2}(r_H^2 - r_L^2).\end{aligned}$$

Note that $\tilde{\imath}^A = i^A < i^{FB}$ and $i^B < \tilde{\imath}^B < i^{FB}$. Intuitively, under A-ownership party A's disagreement payoff is relatively large, so when party B offers a contract at date 3 party A's participation constraint is binding. Hence, party A does not get a rent compared to the situation in which there is no moral hazard, so $\tilde{\imath}^A = i^A$. In contrast, under B-ownership party A's disagreement payoff is zero, so party A gets a rent when there is ex-post moral hazard, implying that party A invests more than in the absence of ex-post moral hazard, $\tilde{\imath}^B > i^B$.

[10] Note that when our assumption $r_\omega \geq R_\omega/2$ does not hold, then $t_1 = R_\omega/2$, so additional case distinctions have to be made. In particular, $\tilde{\imath}^A$ can then be different from i^A. It is straightforward to analyze the cases ruled out by our assumption, which we have made for brevity of the presentation only.

Observe that $\tilde{\imath}^A > \tilde{\imath}^B$ holds whenever $r_H^2 - r_L^2 > \frac{1}{4}(R_H^2 - R_L^2)$. Hence, the following result holds.

Proposition 2 *Suppose there is ex-post moral hazard.*

(i) If $r_H^2 - r_L^2 > \frac{1}{4}(R_H^2 - R_L^2)$, then the date-1 investment is strictly larger under $o = A$ than under $o = B$.

(ii) If $r_H^2 - r_L^2 < \frac{1}{4}(R_H^2 - R_L^2)$, then the date-1 investment is strictly larger under $o = B$ than under $o = A$. In particular, ownership matters even when the investment i is fully relationship-specific ($r_H = r_L$).

Thus, in case (i) the conclusion is as in the standard Grossman-Hart-Moore theory. Yet, in case (ii) it turns out that B-ownership yields higher investment incentives, even though only party A has to make an investment decision. The reason is that the expected rent that party A gets under B-ownership in the case of ex-post moral hazard can be more responsive to party A's investment than party A's positive disagreement payoff under A-ownership. In particular, B-ownership leads to higher investment incentives than A-ownership when the investment is fully relationship-specific; i.e., when the investment has an impact only on the collaboration surplus but not on the disagreement payoffs.

5 Conclusion

In the Grossman-Hart-Moore property rights theory, there are no ex-post frictions. Yet, in transaction cost economics, ex-post frictions play a central role. In this short paper, we have introduced ex-post moral hazard into the Grossman-Hart-Moore theory. In contrast to the standard model, ownership by the non-investing party can yield higher investment incentives than ownership by the investing party. Moreover, even when the investments are fully relationship-specific, ownership matters for the incentives to invest.

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