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Abstract

When two parties invest in human capital and at the same time decide on know-how disclosure it can be shown that joint ownership with veto power is the optimal ownership structure, given that only incomplete contracts can be written.

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1 Introduction

One of the most prominent results in the literature on incomplete contracts and property rights as pioneered by Hart and Moore (see Hart and Moore, 1990, Moore, 1992, and Hart, 1995) says that not more than one agent should have veto power over an asset. This conclusion crucially depends on Hart and Moore's assumption that property rights only matter as far as they influence the parties' incentives to make investments in human capital, which may be called "self-investments" (following Che and Hausch, 1997).[1] However, in the context of research joint ventures, the surplus which may be generated by the parties usually also depends on how much know-how they disclose to each other.[2] Since such disclosure is directly beneficial to the other party, it is a kind of "cooperative investment" in the sense of Che and Hausch (1997). We argue that the necessity to provide incentives for investment in human capital as well as for know-how disclosure may lead to conclusions which are in sharp contrast to Hart and Moore's findings. In particular, it may well be

[1] We follow Hart and Moore and do not consider investments in physical capital (cf. Hart and Moore, 1990, p. 1132, and Hart, 1995, p. 68). Note that there are two other papers which show that it may be beneficial to give veto-power to more than one agent: Halonen (1995), who considers a repeated game, and De Meza and Lockwood (1998), who change Hart and Moore's assumption about the renegotiation process.

[2] The importance of know-how disclosure in research joint ventures has been emphasized by Bhattacharya, Glazer and Sappington (1992), Gandal and Scotchmer (1993), and d'Aspremont, Bhattacharya and Gérard-Varet (1995). However, their focus is on optimal complete contracts.

optimal to give both parties veto-power.[3]

2 The model

Consider two parties, A and B, who can form a joint venture at date $t = 0$ and generate a surplus $v(a, b, \alpha, \beta) \geq 0$ at some future date $t = 3$. At date $t = 1$ both parties decide simultaneously on two non-contractible actions which positively influence the achievable surplus. Party A chooses a level of relationship-specific investment $a \in \mathbb{R}^+$, which is measured by its cost, and a level of know-how disclosure $\alpha \in [\underline{\alpha}, \overline{\alpha}]$, where $\overline{\alpha}$ denotes $A's$ total know-how and $\underline{\alpha} \geq 0$ denotes the level of know-how that is immediately disclosed to B by $A's$ mere presence at date $t = 1$. Analogously, B chooses $b \in \mathbb{R}^+$ and $\beta \in \left[\underline{\beta}, \overline{\beta}\right]$. Know-how disclosure by party A is assumed to increase the effectiveness of $B's$ investment and vice versa. Surplus can only be generated with the help of an asset. At date $t = 0$, the parties write a contract on the allocation of ownership rights over the asset.

At date $t = 2$, the parties can decide whether to continue their joint venture. We assume that continuation is always efficient. Hence, according to the Coase-theorem, bargaining at $t = 2$ will always lead to an affirmative decision. However, how the surplus is shared depends on the allocation of ownership rights which determine the threatpoint in the bargaining over the

[3] Che and Hausch (1997) briefly consider the consequences of cooperative investments for the issue of asset ownership in their footnote 29. However, they suggest that Hart and Moore's findings are confirmed and do not further pursue the issue.

use of the asset. The threatpoints reflect the payoffs each party can realize on its own. We consider four different ownership structures, $o \in \{A, B, JV, JN\}$. If party A is the owner of the asset $(o = A)$, it earns $w^A(a, \beta)$ if bargaining breaks down, and it can prevent the other party from using the asset, hence $B's$ payoff is 0. Note that w^A does not depend on b, since $B's$ investment is in human capital. Of course, A can use its total know-how $\overline{\alpha}$, which we suppress in the notation. If party B is the owner $(o = B)$, its threatpoint payoff is given by $w^B(b, \alpha)$, while A gets a payoff of 0. We additionally consider two kinds of joint ownership: If there is one physical asset joint ownership usually means that each party has veto power and can block the other party from using the asset, i.e., each party receives a payoff of 0 if negotiation breaks down. We call this case *joint ownership with veto power* $(o = JV)$. On the other hand, if the asset is a patent, joint ownership can also mean that each party may use the asset for its own purpose (see Hart, 1995, p. 48, and the literature cited there). In this case A receives a payoff of $w^A(a, \beta)$ and B of $w^B(b, \alpha)$ if negotiation breaks down. This case we call *joint ownership with no veto power* $(o = JN)$.[4]

We assume for simplicity that $v(a, b, \alpha, \beta) = v^A(a, \beta) + v^B(b, \alpha)$, where $v^A(a, \beta)$ is strictly concave in the investment level and (in order to guarantee interior solutions) we impose $\lim_{a\to 0} v_a^A(0, \beta) = \infty$ and $\lim_{a\to\infty} v_a^A(a, \beta) = 0$

[4]Hence we assume that firms do not compete on the same product market after negotiations have broken down. One could simply relax this assumption and assume that the payoffs are smaller than $w^A(a, \beta)$ and $w^B(b, \alpha)$. However, our aim is to show that $o = JN$ may be the worst ownership structure, *even though* the firms do not compete.

$\forall\beta$.[5] Similar conditions are supposed to hold for v^B, w^A, and w^B. In order to capture the idea of relationship specificity, we assume in correspondence to Hart and Moore that the total surplus as well as the marginal returns of investment are larger if the joint venture is continued, i.e., $\forall a, b, \alpha, \beta$: $v(a, b, \alpha, \beta) > w^A(a, \beta) + w^B(b, \alpha)$, $v_a^A(a, \beta) > w_a^A(a, \beta) > 0$, and $v_b^B(b, \alpha) > w_b^B(b, \alpha) > 0$.

The know-how of a party is assumed to be a less-than-perfect substitute for the presence of this party in the joint venture. If no know-how has been disclosed, the continued presence of B in the joint venture increases $A's$ payoff from $w^A(a, \underline{\beta})$ to $v^A(a, \underline{\beta}) > w^A(a, \underline{\beta})$. Know-how disclosure increases both of these payoffs. The more know-how has been disclosed by party B, the less important is its further presence in the joint venture. But some part of $B's$ abilities is not transferable and therefore cannot be communicated via know-how disclosure. Hence, $v^A(a, \underline{\beta}) - w^A(a, \underline{\beta}) > v^A(a, \overline{\beta}) - w^A(a, \overline{\beta}) > 0$, and similarly for party B. Thus, it seems natural to assume $w_\beta^A(a, \beta) > v_\beta^A(a, \beta) > 0$ $\forall a$ and $w_\alpha^B(b, \alpha) > v_\alpha^B(b, \alpha) > 0$ $\forall b$.

Under these assumptions the *first-best know-how disclosure* levels are given by $\alpha^{FB} = \overline{\alpha}$ and $\beta^{FB} = \overline{\beta}$, and the *first-best investment* levels are uniquely defined by the first-order conditions $v_a^A(a^{FB}, \overline{\beta}) = 1$ and $v_b^B(b^{FB}, \overline{\alpha}) = 1$.

Provided that the surplus from bargaining at date $t = 2$ is split according to the Nash-bargaining solution with equal bargaining powers, it is easily

[5] Throughout, all functions are assumed to be twice continuously differentiable. Partial derivatives are denoted by subscripts.

checked that final payoffs are given by:

$$U^A(a,b,\alpha,\beta|o) = \begin{cases} \frac{1}{2}\left[v(a,b,\alpha,\beta) + w^A(a,\beta)\right] - a & \text{if } o = A \\ \frac{1}{2}\left[v(a,b,\alpha,\beta) - w^B(b,\alpha)\right] - a & \text{if } o = B \\ \frac{1}{2}v(a,b,\alpha,\beta) - a & \text{if } o = JV \\ \frac{1}{2}\left[v(a,b,\alpha,\beta) - w^B(b,\alpha) + w^A(a,\beta)\right] - a & \text{if } o = JN \end{cases}$$

$$U^B(a,b,\alpha,\beta|o) = \begin{cases} \frac{1}{2}\left[v(a,b,\alpha,\beta) - w^A(a,\beta)\right] - b & \text{if } o = A \\ \frac{1}{2}\left[v(a,b,\alpha,\beta) + w^B(b,\alpha)\right] - b & \text{if } o = B \\ \frac{1}{2}v(a,b,\alpha,\beta) - b & \text{if } o = JV \\ \frac{1}{2}\left[v(a,b,\alpha,\beta) - w^A(a,\beta) + w^B(b,\alpha)\right] - b & \text{if } o = JN \end{cases}$$

3 Optimal ownership structures

Separate ownership as well as joint ownership *with veto power* induce the owners to fully disclose their know-how: $U^A_\alpha(a,b,\alpha,\beta|o) > 0$ for $o \in \{A, JV\}$, and $U^B_\beta(a,b,\alpha,\beta|o) > 0$ for $o \in \{B, JV\}$. There is no disclosure by the party who is not the owner when there is separate ownership as well as in case of joint ownership *with no veto power*: $U^A_\alpha(a,b,\alpha,\beta|o) < 0$ for $o \in \{B, JN\}$, and $U^B_\beta(a,b,\alpha,\beta|o) < 0$ for $o \in \{A, JN\}$. Given ownership structure o, the parties' investments in human capital, a^o and b^o, are determined by the first order conditions $U^A_a(a,b,\alpha,\beta|o) = 1$ and $U^B_b(a,b,\alpha,\beta|o) = 1$:

$$\tfrac{1}{2}\left[v_a^A(a^A,\underline{\beta})+w_a^A(a^A,\underline{\beta})\right]=1, \qquad \tfrac{1}{2}v_b^B(b^A,\overline{\alpha})=1,$$

$$\tfrac{1}{2}v_a^A(a^B,\overline{\beta})=1, \qquad \tfrac{1}{2}\left[v_b^B(b^B,\underline{\alpha})+w_b^B(b^B,\underline{\alpha})\right]=1,$$

$$\tfrac{1}{2}v_a^A(a^{JV},\overline{\beta})=1, \qquad \tfrac{1}{2}v_b^B(b^{JV},\overline{\alpha})=1,$$

$$\tfrac{1}{2}\left[v_a^A(a^{JN},\underline{\beta})+w_a^A(a^{JN},\underline{\beta})\right]=1, \qquad \tfrac{1}{2}\left[v_b^B(b^{JN},\underline{\alpha})+w_b^B(b^{JN},\underline{\alpha})\right]=1.$$

For comparison we first consider the standard case without know-how disclosure.

Proposition 1 *Assume that* $\underline{\alpha}=\overline{\alpha}$ *and* $\underline{\beta}=\overline{\beta}$. *The investment levels under the four different ownership structures can be ordered as follows:*

$$a^{FB} > a^A=a^{JN}>a^B=a^{JV}$$

$$b^{FB} > b^B=b^{JN}>b^A=b^{JV}$$

The proposition immediately follows from the preceding discussion. Note that there is always underinvestment with respect to the first-best, so that an ownership structure that induces both parties to invest more also yields a larger total surplus. Hence, we have reproduced Hart and Moore's result that joint ownership with veto power is always weakly dominated by separate ownership. Moreover, we find that joint ownership with no veto power is the optimal ownership structure in our model. We can now state our main result.

Proposition 2 *Assume that* $\underline{\alpha}<\overline{\alpha}$ *and* $\underline{\beta}<\overline{\beta}$, *(such that know-how can*

actually be disclosed), and that the following two inequalities hold:[6]

$$\begin{aligned} v_a^A(a,\underline{\beta}) + w_a^A(a,\underline{\beta}) &< v_a^A(a,\overline{\beta}) \\ v_b^B(b,\underline{\alpha}) + w_b^B(b,\underline{\alpha}) &< v_b^B(b,\overline{\alpha}) \end{aligned}$$

Then it follows:

$$\begin{aligned} a^{FB} &> a^{JV} = a^B > a^A = a^{JN} \\ b^{FB} &> b^{JV} = b^A > b^B = b^{JN} \end{aligned}$$

This is exactly the opposite to the standard result. Here bilateral veto power induces parties to disclose their know-how and also to invest more into human capital than ownership structures with unilateral or without veto power. Although possible threat from product market competition is left out of the analysis, parties still do not disclose their know-how: Given they have no veto power, know-how disclosure improves the other party's bargaining position at date $t = 2$. Therefore joint ownership with veto power can be optimal even if investment is in human capital only. If the asset to be owned is an innovation or a patent which can be used by both parties at the same time, joint ownership with no veto power would be optimal in the standard model, while it may be the worst scenario with know-how disclosure.

[6]Note that the conditions may well be satisfied if the marginal return of investment is increasing with know-how disclosure, i.e., $v_{a\beta}^A > 0$ and $v_{b\alpha}^B > 0$, which seems to be plausible. Even if only one of the two inequalities holds, $o = JV$ is better than at least one of the separate ownership structures. Moreover, bilateral veto-power can be optimal even if the inequalities do not hold, since full know-how disclosure may overcompensate lower investment levels.

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