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ABSTRACT

Joint Ownership and Incomplete Contracts: The Case of Perfectly Substitutable Investments

Prominent results of the property rights approach based on incomplete contracts as outlined by Hart (1995) say that all ownership structures lead to underinvestment and that joint ownership cannot be optimal, provided that investments are strategic complements and affect human capital only. We show that in the case of perfectly substitutable investments these conclusions are still true in the static setting, even if investments are in physical capital. However, if the parties can invest and generate a surplus twice, then joint ownership may imply first-best investments in the first stage and can well be the optimal ownership structure.

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NON-TECHNICAL SUMMARY

The property rights approach based on incomplete contracts as outlined by Hart (1995) concludes that all ownership structures lead to underinvestment and that joint ownership cannot be optimal, provided that investments are strategic complements and affect human capital only. We show that in situations in which only the total amount invested matters these conclusions are still true in the static setting, even if investments are in physical capital. If, however, the parties can invest and generate a surplus twice, then joint ownership may imply first-best investments in the first stage and can well be the optimal ownership structure. The reason for our somewhat surprising result that both conclusions can fail if the parties have a second investment opportunity is the fact that given perfectly substitutable investments, the equilibrium investments under joint ownership are not uniquely determined. The multiplicity of equilibria in the second stage can be exploited in order to punish or reward a party's behaviour in the first stage, so that even first-best investments may be sustainable. Since the multiplicity of equilibria arises only under joint ownership, this ownership structure can turn out to be optimal. It is true that in the second stage investments are lower under joint ownership. But this can in some instances be overcompensated by higher investments in the first stage.

Our model seems best to depict cooperative agreements in which both partners either contribute primarily money to the venture, as for example in marketing alliances, or in which firms contribute homogeneous input, as in horizontal production joint ventures. Hence, our model does not cover alliances, which focus on the transfer of technology or the exchange of know-how. We thus focus on those interfirm collaborations that are purely motivated by strategic behaviour and market power. Furthermore, we restrict our attention to those alliances in which investments may not be enforceable. This might be the case if partnering companies originate from different countries or operate in transition countries with underdeveloped legal systems, due to the absence of an international jurisdiction or an underdeveloped jurisdiction within the venture's operating country. Even in developed countries the partners' investments may be difficult to enforce due to 'creative accounting' opportunities. The presented real world cases indicate that in fact joint ownership is observable under the conditions mentioned above.

1 Introduction

Starting with the seminal contribution of Grossman and Hart (1986), several papers have recently studied the optimal allocation of ownership rights in the context of the so-called hold-up problem.[1] Prominent conclusions of this literature say that if only incomplete contracts specifying simple ownership structures can be written, then (a) there will be underinvestment with respect to the first best, and (b) joint ownership of an asset is suboptimal.[2] These results hold under the assumptions that the parties' investments are independent or strategic complements and that the investments are in human capital only. It is well known that, in general, overinvestment may occur if the parties' investments are strategic substitutes (i.e., if the investment incentives of party A increase when party B's investment decreases). It is also known that joint ownership can be optimal in the one-shot setting if investments are in physical capital, i.e., if the parties' default payoffs (what they receive if they fail to collaborate after the investments are sunk) may depend on both parties' investments.[3]

In this paper we consider situations in which only the total amount invested matters, so that the parties' investments are perfect substitutes. Interestingly, it turns out that in this case the standard conclusions (a) and (b) re-emerge, even if investments are in physical capital. This simple observation holds in the usually analyzed one-shot version of the incomplete contracts model. However, if the parties have a second investment opportunity, the results significantly change. In this case it may be possible to induce first-best investments in the

[1] For instance, see Hart and Moore (1990), Moore (1992), Aghion and Tirole (1994), Hart (1995), Nöldeke and Schmidt (1998), and Tirole (1999).

[2] See Hart (1995, p. 41 and p. 48) and Hart and Moore (1990) for a clear exposition of these fundamental results. Note that the result that 'joint ownership of an asset is suboptimal' can be restated by saying that 'strictly complementary assets should be owned together'. If two parties jointly own an asset this means that any asset usage must be agreed by both. This is similar to a situation in which each party owns an asset with the property that value can only be created with both assets together.

[3] See Hart (1995, p. 68).

first stage, and joint ownership may turn out to be the optimal ownership structure.

The reason for our somewhat surprising result that both conclusions can fail if the parties have a second investment opportunity is the fact that given perfectly substitutable investments, the equilibrium investments under joint ownership are not uniquely determined. The multiplicity of equilibria in the second stage can be exploited in order to punish or reward a party's behavior in the first stage, so that even first-best investments may be sustainable. Since the multiplicity of equilibria arises only under joint ownership, this ownership structure can turn out to be optimal. It is true that in the second stage investments are lower under joint ownership. But this can in some instances be overcompensated by higher investments in the first stage.

This is not the only paper that demonstrates the possibility that joint ownership can be optimal in the incomplete contracts framework, even if investments are in human capital. First, applying the folk theorem, Halonen (1995) 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. While our paper is closely related to her work, note that we consider a finitely repeated game and exploit the multiplicity of equilibria in the stage game (cf. Benoît and Krishna, 1985).[4] Second, joint ownership can be optimal if one makes different assumptions about how the parties split the surplus from collaborating after the investments are sunk (see Chiu, 1998, and DeMeza and Lockwood, 1998). In contrast, in this paper we follow the standard model and assume that the parties divide the ex post gains from collaboration equally (cf. Hart, 1995, p. 39).

Notice that Nöldeke and Schmidt (1998) also show that first-best investments may be achievable in the incomplete contracts setting. They assume that parties invest sequentially and allow more complicated ownership ar-

[4] See also Halonen (1997), where it is assumed that there is a fraction of honest players, following the idea of Kreps et al. (1982). We do not make such an assumption. Moreover, note that in her model the ownership structure is renegotiated, which may but need not be the case in our model.

rangements. In this paper we follow most of the property rights literature by assuming that both parties invest simultaneously in each stage and by considering only simple unconditional ownership structures.

The remainder of the paper is organized as follows. In Section 2, the basic model with perfectly substitutable investments is introduced and it is shown that the fundamental insights of the standard model carry over to this case. In Section 3, we demonstrate that these insights may fail if the parties have two investment opportunities. We first assume that the ownership structure cannot be renegotiated, which is meant to capture the idea that often decisions concerning a restructuring of a firm can be made less frequently than investment opportunities arise. We then show in Section 4 that initially allocating ownership to both parties is even more often optimal if the parties can renegotiate the ownership structure at the beginning of the second stage. We discuss the empirical relevance of our analysis in Section 5. Finally, some concluding comments follow in Section 6.

2 The basic model

Consider two parties, A and B, who can by collaboration at some future date $t = 2$ generate a surplus $v \geq 0$ with the help of a physical asset. At date $t = 0$ the parties agree on an ownership structure o over the asset. At date $t = 1$ the parties simultaneously choose levels of relationship-specific investments $a \geq 0$ and $b \geq 0$, respectively. We consider the case in which only the total amount invested matters, i.e. the investments are perfect substitutes. The surplus that can be generated at date $t = 2$ is hence given by $v(a + b)$.

Following the incomplete contracts approach, we assume that the investments and the parties' payoffs are observable, but not contractible. The parties cannot contractually commit themselves ex ante to collaboration at date $t = 2$. At date $t = 0$ the parties can only specify an ownership structure $o \in \{A, B, J\}$.[5] The ownership structure determines the parties' default pay-

[5] We are thus following the by now standard incomplete contract approach (see Hart, 1995). Note that the theoretical foundations are still a matter of ongoing discussions.

offs, i.e. what they receive if they fail to collaborate at date $t = 2$. If party A is the owner of the asset $(o = A)$, the default payoffs are $(w^A(a, b), 0)$. In the absence of collaboration, only party A can use the asset that is needed in order to create value. Party B's investment may, but does not need to influence party A's default payoff.[6] Analogously, if party B owns the asset $(o = B)$, the default payoffs are $(0, w^B(a, b))$. Finally, consider joint ownership $(o = J)$, so that both parties have veto power over the use of the physical asset. In this case the default payoffs are $(0, 0)$, since any asset usage must be agreed by both.

We assume that v, w^A, and w^B are twice differentiable functions with $v' > 0, v'' < 0$, $\lim_{I \to 0} v'(I) > 2$, $\lim_{I \to \infty} v'(I) = 0, w_a^A > 0, w_{aa}^A < 0$, $w_b^A \geq 0$, and $\lim_{a \to \infty} w_a^A(a, b) = 0$, and analogous conditions for w^B.[7] Moreover, also in the spirit of Hart (1995), we assume that $v(a+b) > w^A(a, b)$, $v(a+b) > w^B(a, b)$, $v'(a) > w_a^A(a, 0)$, and $v'(b) > w_b^B(0, b)$. This means that collaboration is always efficient at date $t = 2$ and that collaboration increases the marginal return of a party's investment if the other party has not invested.

In the first-best benchmark solution the parties thus collaborate at date $t = 2$ and choose investment levels $a \geq 0$ and $b \geq 0$ that maximize the total surplus $v(a+b) - a - b$. Under our assumptions, the first-best total investment level $I^{FB} = a + b$ satisfies the first-order condition $v'(I^{FB}) = 1$.

At date $t = 2$, the parties will (in accordance with the Coase Theorem) always agree to collaborate. We follow the standard incomplete contracts approach and model negotiations at date $t = 2$ using the regular Nash bargaining solution.

Che and Hausch (1999) have shown that production contracts are ineffective when the investments are cooperative (i.e., influence the other party's default payoff). See also Hart and Moore (1999) and Maskin and Tirole (1999) for the case of selfish investments and cf. the general discussion in Tirole (1999).

[6] Specifically, in our setting $w^A = w^A(a + b)$ seems to be particularly plausible, which means that the investments are in physical capital.

[7] Primes and subscripts are used as usual in order to denote (partial) derivatives.

Hence, the parties' total payoffs are given by

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

$$U_B(a,b|o) = \begin{cases} \frac{1}{2}\left[v(a+b) - w^A(a,b)\right] - b & \text{if } o = A, \\ \frac{1}{2}\left[v(a+b) + w^B(a,b)\right] - b & \text{if } o = B, \\ \frac{1}{2}\left[v(a+b)\right] - b & \text{if } o = J. \end{cases} \tag{2}$$

We can now derive the parties' investment decisions at date $t = 1$ as follows. Under A-ownership, the parties' investment levels are uniquely characterized by

$$\frac{1}{2}\left[v'(a^A) + w_a^A(a^A, 0)\right] = 1 \tag{3}$$

and $b^A = 0$. In order to see this, take $b = 0$ as given. Then $U_A(a, 0|o)$ is obviously maximized by a^A. Moreover, taking $a = a^A$ as given, note that party B's marginal return of investment is $\frac{1}{2}v'(a^A + b) - w_b^A(a^A, b) - 1$, which is negative since $\frac{1}{2}v'(a^A) - w_b^A(a^A, b) - 1 = -\frac{1}{2}w_a^A(a^A, 0) - w_b^A(a^A, b) < 0$ and v is concave, so that $b = 0$ is optimal.[8] Analogously, under B-ownership the investment levels are given by $a^B = 0$ and

$$\frac{1}{2}\left[v'(b^B) + w_b^B(0, b^B)\right] = 1. \tag{4}$$

Finally, consider joint ownership. In this case the equilibrium investment levels are given by all $a^J \geq 0$ and $b^J \geq 0$ with $a^J + b^J = I^J$, where $\frac{1}{2}v'(I^J) = 1$. We can now state our first result.

Proposition 1 *In the basic model there is always underinvestment with respect to the first-best solution. Moreover, in the basic model joint ownership can never be optimal.*

[8] In order to prove uniqueness, assume that there were an equilibrium $a = \tilde{a}$ and $b = \tilde{b} > 0$. In this case party B's first-order condition would imply $\frac{1}{2}\left[v'(\tilde{a} + \tilde{b}) - w_b^A(\tilde{a}, \tilde{b})\right] = 1$, so that party A's marginal return of investment would be $\frac{1}{2}\left[v'(\tilde{a} + \tilde{b}) + w_a^A(\tilde{a}, \tilde{b})\right] - 1 = \frac{1}{2}\left[w_a^A(\tilde{a}, \tilde{b}) + w_b^A(\tilde{a}, \tilde{b})\right] > 0$. Hence, party A would have an incentive to deviate by choosing $a > \tilde{a}$, which yields a contradiction.

Proof. See the appendix. ■

Hence, the parties agree on A-ownership if $v(a^A) - a^A \geq v(b^B) - b^B$, i.e. if $a^A \geq b^B$, and on B-ownership otherwise.[9] The proposition shows that two of the most prominent results from the incomplete contracts literature (see Hart, 1995) also hold in the case of perfectly substitutable investments, even if investments are in physical capital. However, we will show in the following section that these simple results do no longer need to be true if the parties have a second investment opportunity after date $t = 2$.

3 The dynamic game

Consider now the straightforward extension of the basic model in which the game starting after the ownership structure has been determined is repeated once. Specifically, at date $t = 0$ the parties agree on an ownership structure $o \in \{A, B, J\}$. At date $t = 1$ they simultaneously choose investment levels a_1 and b_1, and at date $t = 2$ they can generate a surplus of $v(a_1 + b_1)$ by collaboration. At date $t = 3$ the second stage begins. The parties choose investment levels a_2 and b_2, and by collaborating at date $t = 4$ they can again create a value of $v(a_2 + b_2)$. The sequence of events is illustrated in Figure 1. All assumptions made in the basic model are assumed to hold analogously for the two stages of the present model.[10]

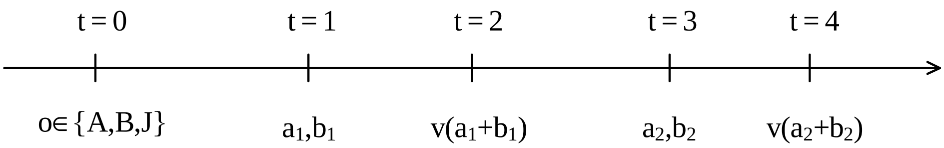

Figure 1. The time structure

[9] As usual, we assume that the parties can make lump sum transfers at date $t = 0$, so that they always agree on the ownership structure that maximizes total surplus.

[10] It is straightforward to generalize our model to the case in which the functions v, w^A, and w^B are different in the two stages. Since this would only complicate the exposition without yielding additional economic insights, we confine attention to the case in which the functions are identical in both stages.

Applying backward induction, we can now make use of the results of the previous section. At date $t = 3$, the parties choose $a_2^A = a^A$ and $b_2^A = 0$ in the case of A-ownership, while they choose $a_2^B = 0$ and $b_2^B = b^B$ in the case of B-ownership. In the case of joint ownership, they choose investment levels such that $a_2^J + b_2^J = I^J$.

Now consider the parties' decisions at date $t = 1$. Given ownership structure o, they choose

$$a_1^o = \arg\max_{a_1} U_A(a_1, b_1^o|o) + U_A(a_2^o, b_2^o|o), \quad (5)$$

$$b_1^o = \arg\max_{b_1} U_B(a_1^o, b_1|o) + U_B(a_2^o, b_2^o|o). \quad (6)$$

Note that a_2^o and b_2^o are uniquely determined for $o \in \{A, B\}$. Therefore, in these cases the continuation payoffs $U_A(a_2^o, b_2^o|o)$ and $U_B(a_2^o, b_2^o|o)$ cannot depend on a_1 and b_1, so that we must have $a_1^o = a^o$ and $b_1^o = b^o$. In the case of joint ownership, however, there is no unique equilibrium combination of the parties' second stage investments. The logic of subgame perfection does not rule out that the second stage investments depend on the first stage investments. This fact will be exploited in the following lemma.

Lemma 1 *If the parties have two investment opportunities, then under joint ownership it is possible to attain $\hat{I} \geq I^J$ as total investment level in the first stage if and only if*

$$\frac{1}{2}v(\hat{I}) - \hat{I} \geq \frac{1}{2}v(I^J) - 2I^J. \quad (7)$$

Proof. See the appendix. ■

Obviously, it is always possible to attain the investment level of the static game, $\hat{I} = I^J$. But more than this may be achievable. In particular, the lemma implies that a sufficient condition for $\hat{I} = I^{FB}$ to be sustainable is that $I^{FB} \leq 3I^J$ holds.[11] We have already argued that, in contrast, under $o \in \{A, B\}$ there will always be underinvestment in both stages. Joint ownership is optimal whenever the weaker second-stage investment incentives can be

[11] In order to see this, note that for $\hat{I} = I^{FB}$ condition (7) is equivalent to $v(I^{FB}) - I^{FB} \geq v(I^J) - I^J + (I^{FB} - 3I^J)$, which obviously holds if $I^{FB} \leq 3I^J$.

overcompensated by stronger investment incentives in the first stage. We thus obtain the following result.

Proposition 2 *Joint ownership is the only ownership structure that may induce first-best investment in the first stage. Moreover, joint ownership dominates $A-$ and $B-$ownership whenever*

$$v(\tilde{I}) - \tilde{I} + v(I^J) - I^J \geq 2\max\{v(a^A) - a^A, v(b^B) - b^B\}, \tag{8}$$

where $\tilde{I} = I^{FB}$ if $\frac{1}{2}v(I^{FB}) - I^{FB} \geq \frac{1}{2}v(I^J) - 2I^J$, and $\tilde{I} \in (I^J, I^{FB})$ with $\frac{1}{2}v(\tilde{I}) - \tilde{I} = \frac{1}{2}v(I^J) - 2I^J$ otherwise.

Proof. See the appendix. ■

Note that if $o = J$, then at the beginning of the second stage the parties have an incentive to change the ownership structure. So far we have assumed that this is not possible. In the following section we analyze what happens in more flexible environments in which this assumption is not valid.

4 Renegotiation of the ownership structure

Assume now that at date $t = 2.5$ the parties have the possibility to renegotiate the ownership structure. Recall from Section 2 that joint ownership is suboptimal in the static setting, so that the parties will switch to $A-$ or $B-$ownership at date $t = 2.5$, which means that the second stage investment levels are uniquely determined. At first sight, one might guess that the renegotiation prospect will hence eliminate the force of the dynamic incentives highlighted in the previous section. However, we will now show that this is actually not the case.

Let $o_1 \in \{A, B, J\}$ denote the original ownership structure, and let o_2 be the optimal ownership structure of the second stage game. Following the Coase Theorem, bargaining at date $t = 2.5$ will always lead to o_2. We assume that the parties split the renegotiation surplus according to the Nash bargaining solution. The characterization of the second stage equilibrium investment levels remains unchanged. However, the parties' investment choices at date $t = 1$ are now characterized by

$$a_1^o = \arg\max_{a_1} U_A(a_1, b_1^{o_1}|o_1) + U_A(a_2^{o_1}, b_2^{o_1}|o_1) + \frac{1}{2}\Delta, \quad (9)$$

$$b_1^o = \arg\max_{b_1} U_B(a_1^{o_1}, b_1|o_1) + U_B(a_2^{o_1}, b_2^{o_1}|o_1) + \frac{1}{2}\Delta, \quad (10)$$

where $\Delta = U_A(a_2^{o_2}, b_2^{o_2}|o_2) + U_B(a_2^{o_2}, b_2^{o_2}|o_2) - [U_A(a_2^{o_1}, b_2^{o_1}|o_1) + U_B(a_2^{o_1}, b_2^{o_1}|o_1)]$ denotes the renegotiation surplus. Note that $o_2 \in \{A, B\}$ due to Proposition 1. If $o_1 \in \{A, B\}$, then the investments are still given by the levels characterized in the analysis of the static game. If $o_1 = J$, then $a_2^{o_1}$ and $b_2^{o_1}$ can again depend on the first stage investments. Notice that $\Delta = v(I^{o_2}) - I^{o_2} - \left[v(I^J) - I^J\right]$, where $I^{o_2} = a_2^{o_2} + b_2^{o_2}$. Hence, Δ does not depend on the individual first stage investment levels, so that (5) and (6) only differ from (9) and (10) by a constant. Therefore, under $o_1 = J$ the same investment levels that were sustainable without renegotiation (see Lemma 1) remain sustainable when renegotiation is possible. What is important is the fact that the parties' threatpoint payoffs $U_A(a_2^J, b_2^J|J)$ and $U_B(a_2^J, b_2^J|J)$ can depend on the first stage investments in the same way as the parties' second stage payoffs in the previous section. We thus get the following result.

Proposition 3 *If the ownership structure can be renegotiated at date* $t = 2.5$, *the sustainable investment levels remain unchanged. Moreover, joint ownership dominates* $A-$ *and* $B-$*ownership whenever*

$$v(\tilde{I}) - \tilde{I} \geq v(I^{o_2}) - I^{o_2}, \quad (11)$$

where $\tilde{I}$ *is defined as in Proposition 2,* $o_2 = A$ *if* $a^A \geq b^B$, *and* $o_2 = B$ *otherwise.*

Proof. This follows immediately from the preceding discussion. ■

Of course, if $\tilde{I} = I^{FB}$, then $o_1 = J$ is always optimal. Notice that if joint ownership is optimal in the absence of renegotiation according to Proposition 2, then $o_1 = J$ is also optimal if the ownership structure can be renegotiated (cf. (8) and (11)). However, if renegotiation is possible, $o_1 = J$ can even be optimal if it were dominated in the absence of renegotiation.

5 A simple illustration

As an illustration, consider the following simple example. Let $v(a+b) = \sqrt{a+b}$, $w^A(a,b) = \frac{1}{8}v(a+b)$, and $w^B(a,b) = \frac{x}{8}v(a+b)$. It is straightforward to check that all our assumptions are satisfied for $x \in (0,8)$. In Figure 2 total surplus as a function of x is illustrated for the one-stage case. Joint ownership can never be optimal. B-ownership is obviously better than A-ownership whenever $x \geq 1$, since then B's investment incentives under $o = B$ are stronger than A's incentives under $o = A$.

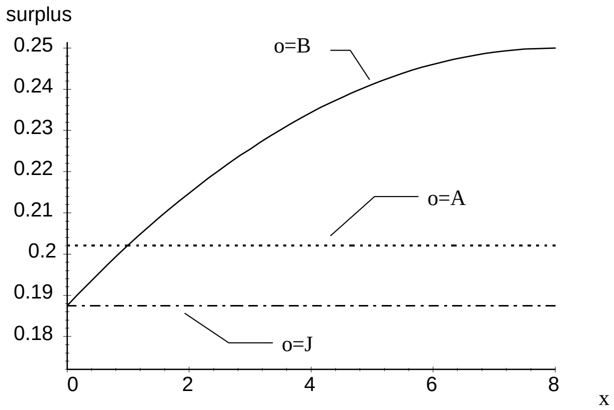

Figure 2. The parties invest once

However, these simple findings significantly change in the two-stages case (see Figure 3). In this case joint ownership can induce first-best investments in the first stage and is always better than A-ownership. Joint ownership is also better than B-ownership if x is sufficiently small (i.e., smaller than $8 - 4\sqrt{2} \approx 2.34$). If x is large, B-ownership is optimal because then B has strong investment incentives, so that underinvestment in both stages is relatively small under $o = B$, while there is relatively severe underinvestment in the second stage under $o = J$.

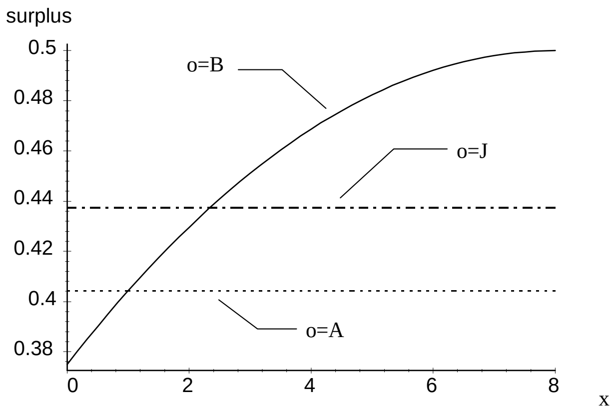

Figure 3. The parties invest twice (no renegotiation)

Finally, if the ownership structure can be renegotiated at date $t = 2.5$, then under $o_1 = J$ first-best investment can be sustained in the first stage, and in the second stage the parties choose $A-$ownership if $x \leq 1$, and $B-$ownership otherwise. Therefore, joint ownership is always optimal in this case.

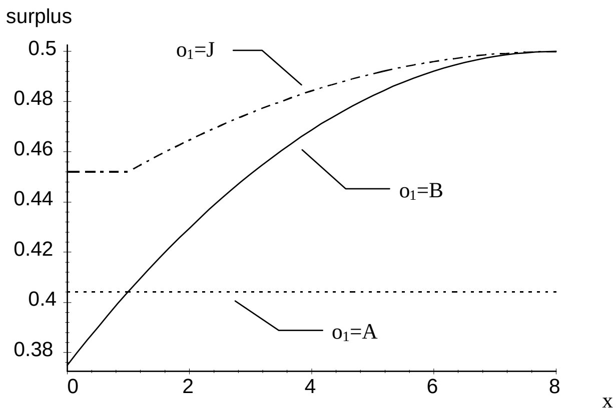

Figure 4. The parties invest twice (renegotiation)

More generally, consider $v(a+b) = (a+b)^{\sigma}$ with $\sigma \in (0,1)$. It is straightforward to verify that the first best investment level is sustainable in the first stage under joint ownership whenever $\sigma \leq \frac{1}{2}$. Hence, if $\sigma \geq \frac{1}{2}$, then $o_1 = J$ can be suboptimal even if renegotiation of the ownership structure is possible, i.e., for sufficiently large values of x the parties would always prefer $B-$ownership.

To summarize, our model suggests that we may well observe joint ownership in situations in which only the total amount invested matters, provided that the parties have a second investment opportunity. In the following section we identify conditions under which the parties' investments may in fact be perfectly substitutable and non-contractible, and we briefly discuss some real world cases of joint ventures that seem to be consistent with our analysis.

6 Empirical relevance

Under the pressure of ongoing globalization of the world's economy, strategic alliances and joint ventures have become important elements of many firms' international strategies. Anand and Khanna (2000) report that during the last 2 years alone more than 20.000 new alliances were formed worldwide. Bleeke and Ernst (1995) report that in the early nineties the number of alliances has grown by more than 25% annually. Cooperative settlements range from simple (contractual) agreements with no equity ties to more formal arrangements involving equity ownership and shared managerial control over joint activities.[12] As opposed to mergers or internal growth strategies, alliances allow for a quick and flexible response to changing market parameters. Chan et al. (1997) find that in their sample of 345 non-equity alliances the average life span of an alliance is about five years and that at least 18% of all alliances announce the signing of new agreements or a change to the status of the alliance. Bleeke and Ernst (1995) report for their sample of 200 alliances a median life span of seven years and observe that nearly 80% of joint ventures end in a sale by one of the partners. Yan and Gray (1994) argue that joint ventures need to reconfigure over time to ensure stability and overall performance. Furthermore, analyzing the relationship between control and performance in four alliances between US and Chinese firms, they conclude that shared or split control is superior for international joint ventures in developing countries. Beamish (1992) comes to similar conclusions comparing 12 studies published since 1986 and analyzing a new sample of 22 Sino-foreign joint ventures.[13]

[12] See Chan et al. (1997) or Oxley (1997).

[13] Control rights in a joint venture are related to the voting rules at the board of directors, the highest decision-making body in a joint venture, as well as the board representation.

Our model seems to best depict cooperative agreements in which both partners either contribute primarily money to the venture, as for example in marketing alliances, or in which firms contribute a homogenous input, as in horizontal production joint ventures, such that only total investment matters for the venture's success.[14] We thus focus on those inter-firm collaborations which are purely motivated by strategic behavior and market power objectives and which, according to Hennart (1988), are labeled as 'scale joint ventures'.[15] Furthermore, we restrict our attention to those alliances in which investments may not be enforceable. This might be the case if partnering companies stem from different countries or operate in transition countries with underdeveloped legal systems, due to the absence of an international jurisdiction or an underdeveloped jurisdiction within the venture's operating country.[16] Even in developed countries the partners' investments may be difficult to enforce due to "creative accounting" opportunities.[17]

One of the most rapidly developing markets in recent times is the Internet market and it is not surprising that many firms in this area form strategic

Bai et al. (1999) argue that there is no substantial difference in the degree of joint control between the 50-50 joint ventures and other joint ventures. Critical for the "jointness" of control is the number of important decisions for which either unanimous voting or two-thirds majority is required. Killing (1982) specifies 9 important decisions, Bai et al. refer to 13 decisions, inter alia the hiring of the CEO.

[14] Hence, our model does not cover alliances which focus on the transfer of technology or the exchange of know-how. See Rosenkranz and Schmitz (1999) for an analysis of the issue of know-how exchange in the framework of incomplete contracts.

[15] Note that in the sample of Chan et al. (1997) about 43% of alliances focus on marketing agreements.

[16] For example, Beamish (1992) reports that in the People's Republic of China agreements for more than 20000 alliances with foreign partners were signed during the past decade. Bai et al. (1999) find in their sample of 200 Chinese joint ventures a 97.5% involvement of foreign partners, from which 30% are from the US, Canada or Japan.

[17] Laffont and Tirole (1993, p. 88) point out that even monetary investments can create measurement problems. For instance, the parties' investments may be the amounts they spend to buy certain inputs. A party may collude with the seller of such an input in order to make the investment level appear higher than it actually is.

alliances. In addition to a growing number of technology alliances one can also find a significant number of marketing alliances. Especially the joint provision of Internet portals seems to be a valuable field for interfirm collaborations in marketing and branding.

As an example for an alliance with a sequence of projects consider the joint venture of Lycos Inc. and Singapore Telecommunications. In September 1999, the two companies founded Lycos Asia as a 50:50 joint venture for the provision of local portals to ten Asian markets. Their first project was the launch of an Internet portal in Singapore. The second project, announced in April 2000, was the simultaneous launch in Hong Kong, China and Taiwan. As our theory predicts, the joint venture is under joint control of the two partners.[18]

In November 1999, Microsoft Corporation and Telmex, Mexico's largest telecommunication company, announced to cooperate on the provision of a Spanish-language Internet portal for the Americas. The portal "T1mns" came online early 2000 and the venture's first marketing initiative targeted at Mexico. As announced upfront, the second joint promotion project will target on the Hispanic population in the U.S. and Canada. Also in this (dynamic) alliance the two firms share control as equal partners.[19]

To mention a final example, in June 1999 NBC and CNET formed a joint venture to operate the "Snap!" Internet portal service. In July the alliance started with a brand-awareness promotional campaign, preceding a full launch campaign scheduled for fall. "Snap!" was initially owned 81% by CNET, but key NBC executives had five seats at the board of directors, such that the two firms jointly controlled the venture.[20]

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[18] See InternetNews, January 20, 2000 and Lycos Asia press releases. We consider the reported unanimous appointment for the ventures' CEO to indicate joint control.

[19] See Business Week, November 8, 1999, p. 52.

[20] NBC retained the option to increase its ownership stakes to 60%. See InternetNews, July 21, 1999.

7 Concluding remarks

We have demonstrated that in a straightforward variant of the by now standard incomplete contracts model in which investments are perfect substitutes some of the main conclusions change if the parties can invest twice instead of once. Joint ownership can turn out to be optimal and first-best investment may be achievable in the first stage. We would like to add the following remarks.

First, even if investments are not perfect substitutes, the best response curves may in general intersect in several points (also if they are increasing, i.e., with strategic complementarities), so that multiple equilibria can occur. In these instances first-best investment levels may still be sustainable in the first stage when dynamic punishments are used. Yet, note that the equilibria constructed in our model are "renegotiation-proof" in the sense of Benoît and Krishna (1993), i.e., deviations in the first stage are *not* punished by Pareto-dominated equilibria in the second stage. This property will not generally be satisfied if the investments are not perfectly substitutable.

Second, while we consider a situation in which it does not matter who invests in a given stage, it is important when the investments take place. If investments were both intra- and inter-temporally substitutable, so that the collaboration payoff which could eventually be generated were given by $v = v(a_1 + b_1 + a_2 + b_2)$, it would no longer be possible to induce the parties to invest more than I^J under joint ownership.[21]

Third, note that in our model there are always highly inefficient equilibria under joint ownership (for example, $a_1^J = b_1^J = a_2^J = b_2^J = \frac{I^J}{2}$). Yet, it is a usual assumption in contract theory that the parties can implicitly agree on an efficient equilibrium.[22] Moreover, our results depend on the assumption that

[21] In order to see this, note that under $o = J$ the investments in the second stage must now satisfy $a_2^J + b_2^J = \max\{I^J - a_1^J - b_1^J, 0\}$.

[22] For a discussion of this point and the potential tension between contract theoretic and game theoretic points of view see also the discussions in Gale and Hellwig (1989) and Schweizer (1999).

the parties split the ex post gains from collaboration equally. This assumption is made in most incomplete contract models. Finally, while our results for the two-stage case are in contrast to the usual conclusions of the literature, they certainly reinforce what may be the most important contribution of the property rights approach, namely the conjecture that given incomplete contracts ownership does have an important influence on investment decisions and thus on efficiency.

Appendix

Proof of Proposition 1.

If $o = A$, then total investments are given by $I^A = a^A$, which is smaller than I^{FB}, due to concavity and $w_a(a, 0) < v'(a)$. Moreover, $I^J < a^A$, due to concavity and $w_a > 0$. Analogous conclusions hold for $o = B$. Hence, there is always underinvestment with respect to the first-best solution and joint ownership is suboptimal. ■

Proof of Lemma 1.

It is straightforward to see that the worst second stage equilibrium for a party requires the party to invest I^J. Hence, all first stage investment levels that can be sustained under $o = J$ can be attained if a party's deviation in the first stage triggers this equilibrium in the second stage. Therefore, consider the following strategy of party A. At date $t = 1$, party A chooses $a_1 = a_1^J$. If party B has chosen $b_1 = b_1^J$, then party A chooses $a_2 = a_2^J$ at date $t = 3$, otherwise she chooses $a_2 = 0$. If she had chosen $a_1 \neq a_1^J$ against her plan, she would choose $a_2 = I^J$ if $b_1 = b_1^J$, and $a_2 = a_2^J$ otherwise. Party B uses a symmetric strategy.

When does this pair of strategies form a subgame perfect equilibrium? Note first that in all second stage subgames the sum of the parties' investments equals I^J, which is consistent with equilibrium. Consider now date $t = 1$. Given party B's strategy, it is straightforward to see that it is rational for party A to choose $a_1 = a_1^J$ whenever

$$\frac{1}{2}v(a_1^J + b_1^J) - a_1^J + \frac{1}{2}v(I^J) - a_2^J \geq \frac{1}{2}v(a_1 + b_1^J) - a_1 + \frac{1}{2}v(I^J) - I^J \quad (12)$$

for all $a_1 \neq a_1^J$. Since $\frac{1}{2}v(I) - I$ is maximized by I^J, the most profitable deviation would be $a_1 = \max\{I^J - b_1^J, 0\}$. Hence, the condition can be rewritten as

$$\frac{1}{2}v(a_1^J + b_1^J) - a_1^J - b_1^J \geq \frac{1}{2}v\left(\max\{b_1^J, I^J\}\right) - \max\{b_1^J, I^J\} - b_2^J. \quad (13)$$

An analogous condition holds for party B,

$$\frac{1}{2}v(a_1^J + b_1^J) - a_1^J - b_1^J \geq \frac{1}{2}v\left(\max\{a_1^J, I^J\}\right) - \max\{a_1^J, I^J\} - a_2^J. \quad (14)$$

Hence, all investment tuples $(a_1^J, b_1^J, a_2^J, b_2^J)$ that satisfy (13), (14), and $a_2^J + b_2^J = I^J$ can be sustained in equilibrium.

Let $(\hat{a}_1^J, \hat{b}_1^J, \hat{a}_2^J, \hat{b}_2^J)$ with $\hat{a}_1^J + \hat{b}_1^J = \hat{I} \geq I^J$ be such a sustainable tuple. We will show that then the first stage total investment $\hat{I}$ can also be attained with $a_1^J = 0, b_1^J = \hat{I}, a_2^J = I^J, b_2^J = 0$. Note that this new tuple of investments can be sustained whenever

$$\frac{1}{2}v(\hat{I}) - \hat{I} \geq \frac{1}{2}v\left(I^J\right) - 2I^J, \tag{15}$$

which follows from (14) and the fact that (13) holds with equality. It remains to show that (15) is implied by the fact that the conditions (13) and (14) hold for $(\hat{a}_1^J, \hat{b}_1^J, \hat{a}_2^J, \hat{b}_2^J)$. This is indeed the case, since adding up the latter two conditions implies

$$\begin{aligned} v(\hat{I}) - 2\hat{I} &\geq \frac{1}{2}v\left(\max\{\hat{I} - \hat{a}_1^J, I^J\}\right) - \max\{\hat{I} - \hat{a}_1^J, I^J\} \\ &\quad + \frac{1}{2}v\left(\max\{\hat{a}_1^J, I^J\}\right) - \max\{\hat{a}_1^J, I^J\} - I^J \\ &\geq \frac{1}{2}v(\hat{I}) - \hat{I} + \frac{1}{2}v(I^J) - I^J - I^J, \end{aligned}$$

where the last inequality holds since $\frac{1}{2}v\left(\max\{\hat{I} - a_1^J, I^J\}\right) - \max\{\hat{I} - a_1^J, I^J\} + \frac{1}{2}v\left(\max\{a_1^J, I^J\}\right) - \max\{a_1^J, I^J\}$ is minimized by $a_1^J = 0$, as can easily be verified using the fact that v is concave. ■

Proof of Proposition 2.

The first part immediately follows from the discussion preceding the proposition. In order to see that the second part is true, note that under joint ownership the best sustainable first stage investment level can according to Lemma 2 be found by maximizing $v(I) - I$ subject to $\frac{1}{2}v(I) - I \geq \frac{1}{2}v(I^J) - 2I^J$. The solution to this problem is obviously given by $I = I^{FB}$ if I^{FB} is sustainable. Otherwise, the constraint must be binding. Note that in the latter case a unique second-best $\tilde{I} \in (I^J, I^{FB})$ must exist since the constraint always holds with strict inequality for $I = I^J$ and $\frac{1}{2}v(I) - I$ is strictly decreasing for $I > I^J$. ■

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