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Fairness and the Optimal Allocation of Ownership Rights

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Abstract: We report on several experiments on the optimal allocation of ownership rights. The experiments confirm the property rights approach by showing that the ownership structure affects relationship-specific investments and that the subjects achieve the most efficient ownership allocation starting from different initial conditions. However, in contrast to the property rights approach, the most efficient ownership structure is joint ownership. These results are neither consistent with the self-interest model nor with models that assume that all people behave fairly, but they can be explained by the theory of inequity aversion that focuses on the interaction between selfish and fair players.

Keywords: Ownership Rights, Double Moral Hazard, Fairness, Reciprocity, Incomplete Contracts.

JEL Classification Numbers: C7, C9, J3.

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I Introduction

In this paper we take a fresh look at an old question: What is the optimal allocation of ownership rights? The modern property rights approach, pioneered by Grossman and Hart (1986) and Hart and Moore (1990), argues that in a world of incomplete contracts the allocation of ownership rights matters because it assigns residual rights of control. These control rights affect the incentives of the involved parties to make relationship specific investments that cannot be contracted upon directly. Grossman, Hart and Moore show that typically no allocation of ownership rights induces first best investments, but that some ownership structures are more efficient than others. Therefore, the involved parties will trade ownership rights ex ante in order to set up the second best optimal ownership structure.[1] Another prominent result of this literature (see e.g. Hart, 1995) is that joint ownership is rarely optimal. The reason is that if both parties own an asset, then they can prevent each other from using the asset which minimizes the threatpoint payoffs of both parties. Giving all the ownership rights to one party increases this party's threatpoint payoff and investment incentives without affecting the incentives of the other party.

In the first part of this paper we report on several experiments on the optimal allocation of ownership rights. In the experiments players first have to bargain on the allocation of ownership rights on a joint project (a "firm"). They can either have joint ownership, or one of the parties can be the sole owner and hire the other party as an employee. Then the two parties can make relationship specific investments that increase the joint surplus to be generated. Finally the surplus is shared according to the ex ante chosen allocation of ownership rights. We are interested in two main questions: First, which ownership structure is (second-best) efficient, in the sense that it induces the most efficient investment decisions of the two parties? Second, do the experimental subjects understand what the most efficient ownership structure is and do they manage to set up this ownership structure ex ante? In order to address the second question we consider two different experimental designs. In the Joint Ownership Design (JOD) parties start with joint ownership but one of the parties can try to sell her ownership stake to the other party. In the A-

[1] There is an earlier literature on property rights that comes to somewhat different conclusions. Coase (1960) emphasizes that it is of crucial importance for economic efficiency that property rights are well defined. However, the so called "Coase Theorem" implies that it does not matter for economic efficiency to whom ownership rights are allocated. In the absence of any transaction costs any (well defined) allocation of ownership rights implements an efficient outcome. Williamson (1985) points out that if the parties can write complete contingent contracts, then any ownership structure can be mimicked by an appropriate set of incentive contracts, so the allocation of ownership rights is irrelevant.

Ownership Design (AOD), A owns the whole project initially, but she can give away half of her ownership rights to B. Thus, we can test whether the initial allocation of ownership rights affects the final outcome or whether the parties will always manage to set up the efficient ownership structure.

The experiments confirm the property rights approach by showing that the ownership structure affects relationship-specific investments and that the large majority of the subjects achieve the most efficient ownership allocation starting from different initial conditions. However, in contrast to the prediction of the property rights approach, the most efficient ownership structure turns out to be joint ownership.

In the second part of the paper we offer a theoretical interpretation of the experimental results. The property rights approach is based on the self-interest model that assumes that all parties are only interested in their own material payoffs. However, we know from many experiments and also from systematic field evidence[2] that concerns for fairness and reciprocity play an important role in motivating the behavior of many people. Several experiments (e.g. Fehr, Gächter and Kirchsteiger, 1997, and Fehr, Klein and Schmidt, 2004) point out that if only incomplete contracts can be written, then fairness and reciprocity may act as an enforcement device that complements (and sometimes substitutes for) explicit incentives that are enforced by the courts.

In Section III we compare the prediction of the self-interest model to the predictions of two other approaches. The first approach assumes that it is common knowledge that all parties strongly care about fairness and reciprocity. Models of intention-based reciprocity (Rabin, 1993, or Dufwenberg and Kirchsteiger, 2004) as well as models of social preferences or distributional fairness (Fehr and Schmidt, 1999, or Bolton and Ockenfels, 2000) predict that in this case, the allocation of ownership rights does not matter. Under any allocation of ownership rights, fairness and reciprocity suffice as an enforcement device to induce both parties to invest efficiently.

The second approach acknowledges that people differ. Some people seem to care quite strongly about fairness and reciprocity while other people seem to be mainly self-interested. Furthermore, people often don't know whether they interact with a fair-minded or a self-interested opponent. Using the Fehr-Schmidt (1999) model of inequity aversion, we show that in this case, like in Hart (1995), no ownership structure implements first best investments, and that the allocation of ownership rights does matter. However, in contrast to Hart (1995), joint

[2] See Fehr and Schmidt (2003) for a recent survey on this literature.

ownership is predicted to be the most efficient ownership structure. The players anticipate this and choose to have joint ownership in equilibrium.

In the experiments it turned out that no ownership structure can induce both parties to invest efficiently. Thus, concerns for fairness and reciprocity did not suffice as an enforcement device to achieve the first best. Furthermore, the allocation of ownership rights did matter. However, in contrast to the predictions of the self-interest model, joint ownership was second-best optimal. The large majority of the experimental subjects anticipated this and achieved joint-ownership both in the Joint Ownership Design and in the A-Ownership Design. The Fehr-Schmidt (1999) model of inequity aversion that focuses on the interaction between self-interested and fair players is consistent with these observations.

Our paper is related to several experimental papers on the hold-up problem. Hackett (1994) was the first to investigate experimentally the impact of relationship-specific investments on ex-post bargaining outcomes. Similar studies include Gantner, Güth and Königstein (2001), Königstein and Tietz (2000) and Oosterbeek, Sonnemans and van Velzen (2003). All of these papers show that the hold-up problem is mitigated by concerns for fairness. Ellingsen and Johannesson (2004a, b) look at the role of communication and of threats and promises to induce efficient investments in a hold-up problem with one-sided investments. All of these papers show that concerns for fairness improve investment incentives and facilitate coordination. Ellingsen and Johannesson (2004a, b) apply the Fehr-Schmidt (1999) model of inequity aversion to their experiments and show that this model fits the data much better than the self-interest model. However, none of these papers considers different allocations of ownership rights and how they affect investment incentives.

There are a few theoretical models showing that joint ownership may sometimes be optimal. Rosenkranz and Schmitz (1999) consider a set-up where parties have to engage in multiple types of investments. They show that joint ownership improves the incentives to engage in know-how disclosure which may turn joint ownership to be the optimal ownership structure. Maskin and Tirole (1999) consider a buyer-seller relationship and show that joint ownership combined with an option to sell his or her share of the asset to the other party can implement first best incentives. However, this contract is not collusion-proof. Halonen (2002) considers an infinitely repeated game. In the one-shot game, joint ownership is the worst ownership structure that minimizes investment incentives.[3] However, in the infinitely repeated game this ownership structure is desirable, because it provides the strongest

[3] See also Hart (2001) for a critical discussion of the repeated games approach to the theory of the firm.

punishment possibilities if one of the parties deviates. None of these papers considers the effects of fairness and reciprocity that may be generated by joint ownership.

The rest of the paper is organized as follows. Section II sets up a simple problem of the allocation of ownership rights. Experimental procedures are discussed in Section III. Section IV presents the experimental results. In Section V we offer a theoretical analysis of the experiment under different assumption about preferences and concerns for fairness. Section VI concludes.

II A Simple Problem of the Allocation of Ownership Rights

Consider two players, called A and B, who can generate a joint surplus if they have access to some set of physical assets (called a "firm").[4] The gross surplus $v(a,b)$ depends on the investments $a \geq \underline{a}$ and $b \geq \underline{b}$, undertaken sequentially by the two players. Investments are personally costly with investment costs given by $c_A(a)$ and $c_B(b)$, respectively. For simplicity, let us assume that the problem is symmetric in the sense that $c^A(\cdot) = c^B(\cdot) = c(\cdot)$ and $v(a,b) = v(b,a)$. Suppose that B chooses his investment level first, and that A observes B's investment before she has to invest herself. Let the first best investment levels be denoted by $a*$ and $b*$,

$$(a^*, b^*) = \arg\max S(a,b) = \arg\max v(a,b) - c(a) - c(b),$$

and suppose that they are uniquely defined and satisfy $a^* > \underline{a}$ and $b^* > \underline{b}$, respectively.

The investments are assumed to be unobservable by outsiders, so that any investments above the minimum investment levels $\underline{a}$ and $\underline{b}$ cannot be contracted upon. However, at some initial date 0, the two parties can write a contract on the allocation of ownership rights on the firm and thus on who controls the physical assets that are required for production. If one of the parties, say A, is the sole owner of the firm, then she has to hire B at a fixed wage w as an employee. In this case monetary payoffs are given by

$$M^A = v(a,b) - w - c(a)$$
$$M^B = w - c(b)$$

[4] The physical assets may be machines, buildings or "soft" assets such as a patent or a client list. We assume that the assets have to be owned together, e.g. because there are strong complementarities between them. We do not consider the possibility that each of the agents owns a different subsets of assets. See Hart and Moore (1990) for a detailed analysis of this case.

Clearly, in this case a self-interested B-player will choose $b = \underline{b}$ because the marginal return of his investment is zero. The A-player, however, is full residual claimant on the margin and will invest efficiently (given B's investment). The case of B-ownership is symmetric.

If both parties jointly own the firm, then they share the gross returns of the project equally and payoffs are

$$M^A = 0.5v(a,b) - c(a) - t$$
$$M^B = 0.5v(a,b) - c(b) + t$$

where t is a potential transfer payment that may be necessary to achieve joint ownership. In this case each player gets half of the marginal return of his investment. Thus, under joint ownership self-interested players will not invest efficiently either.[5] Which of the two ownership structures is more efficient depends on the parameters of the surplus and cost functions. Note that this is a simplified version of Hart (1995) with investments in physical rather than in human assets.[6]

We chose the following parameterization of this investment problem for our experiments. The two parties choose $a, b \in \{1, ..., 10\}$. Investments *(a,b)* yield a gross surplus $v(a,b) = 22 \cdot (a+b)$, while investment costs are $c_A(a) = 12a$ and $c_B(b) = 12b$. Thus, investments are neither complements nor substitutes at the margin, so that optimal investment levels are independent of each other.

Given these parameters of the experiment, the efficient investment levels are given by *a*=b*=10* which would yield a joint surplus of 200. However, the self-interest model predicts that there is no ownership structure that implements efficient investments. With joint ownership, each party receives only half of the gross surplus. Thus, the private marginal return of the investment is smaller than its marginal cost, so both parties will choose minimum investment levels, *a=b=1*. If one party is the sole owner of the firm, then this party receives the full gross surplus on the margin and has an incentive to invest efficiently. The

[5] If both players invest simultaneously and if investments are complements at the margin, it is easy to show that both players will underinvest (see, e.g. Hart and Moore, 1990, Proposition 1). With sequential investments, however, B takes into account that his actual investment level may affect the optimal investment level of A. Thus, at this general level it cannot be ruled out that B overinvests (see Noldeke and Schmidt, 1998, Proposition 1). However, in the parameterization of the experiments that we conducted here there is underinvestment in equilibrium under any ownership structure.

[6] If A is the owner of the asset, she gets *v(a,b)*, so she has full access to the returns of B's investment *b*, even without B's consent. If the investment was in human capital, A would not be able to realize *v(a,b)* without B's consent, but she would have to bargain with B in order to bribe him to cooperate. With investments in human capital it is never optimal to have joint ownership. With investments in physical capital, joint ownership may be optimal. However, in the experiments we restrict attention to the case where joint ownership is not optimal with investments in physical capital either.

other party, however, receives a fixed wage and will choose the minimum investment level of 1. Thus, both possible ownership structures are inefficient, but joint ownership is even less efficient than A- or B-ownership.

Before the investments are taken the parties bargain on the allocation of ownership rights. The property rights theory (based on the self-interest model) claims that the parties will always agree on the most efficient ownership structure (i.e. on A- or B-ownership), no matter what the initial allocation of ownership rights is. We consider two different treatments:

- In the *Joint Ownership Design (JOD)* both parties jointly own the firm initially. At stage 0, A can either choose to stick to joint ownership or she can offer to sell her share of the firm to B at price t.
- In the *A-Ownership Design (AOD)* player A is the single owner of the firm when the game starts. At stage 0, A can either choose to remain the sole owner of the firm and to hire B as an "employee" at a fixed wage w. Alternatively, A can choose to make B a co-owner by giving away half of the firm to him.[7]

Our main questions are, first, whether A-ownership is indeed more efficient than joint ownership and, second, whether parties manage to achieve the most efficient ownership structure independent of the initial ownership structure.

III Experimental Procedures

The experiments were conducted at the University of Munich with undergraduate students of law, political science, engineering, etc. In total we conducted eight experimental sessions. Four sessions (S1–S4) implemented the Joint Ownership Design (JOD), two sessions (S5-S6) implemented the A-Ownership Design, and two additional sessions (S7 and S8) implemented a control treatment of JOD with the twist that after A's offer was rejected the game did not end but continued with joint ownership (JOD'). In each session we had 20-24 subjects, half of them in the role of player A, the other half in the role of player B. The two groups were located in separate but adjacent rooms. Before the experiment started, all subjects had to read the instructions and to solve several exercises to make sure that all of them understood the rules of the experiment. In each session we had ten rounds. In each round an A-player was

[7] We did not use the expressions „employee" and „partner" in the actual experiments but rather the neutral terms "actor A" and "actor B".

matched with a different B-player. Thus, in each experimental session we have for each subject ten contracts with ten different anonymous contracting partners.

After each round the subjects had to compute their own payoff and the payoff of their opponent. To rule out the possibility of reputation building, the outcome of each round was strictly confidential, that is, each pair of players observed only what happened in their own relationship. They did not observe the contracts chosen by or offered to the other subjects in the room. Nor did they observe the past behavior of their current partner. Furthermore, the matching was random and anonymous. Finally, at the end of the session the subjects collected their total monetary payoffs privately and anonymously. Each session lasted for about one and a half hours. A complete set of the instructions for all our experiments can be found on our webpage.[8]

In each session all participants received an initial endowment of € 10.00 (≈US $ 12.50 at the time of the experiment). The experimental (token) payoffs were exchanged into money at the rate of 1 token = € 0.03. Thus, A and B could jointly earn a maximum surplus of € 6 in each of the ten rounds. The highest total income of one individual was € 41.00 (≈US $52.00), an hourly wage of about € 27.40 (US $34.25). However, the subjects could also make substantial losses. In order to avoid the possibility that somebody ends up with negative earnings, a subject had to drop out of the experiment if his or her accumulated earnings fell below € 1.00, which never happened.

IV Experimental Results

IV.A Joint Ownership Design

In the Joint Ownership Design (JOD) each party owned 50 percent of the joint venture initially. At stage 0 player A could choose either to stick to joint ownership or to sell her ownership stake to player B. We conducted four sessions (S1-S4) of this design with a total of 470 observations.

[8] The full set of all our experimental instructions, in German and translated into English, are available at http://www.vwl.uni-muenchen.de/ls_schmidt/experiments/property_rights/index.htm .

Result 1: *The large majority of A-players choose to stick to joint ownership. If A-players offer to sell their ownership stake to B, these offers got rejected in about 30 percent of all cases.*

Result 1 is supported by the following figures: In 300 out of 470 cases (63.8 percent) A-players chose to stick to joint ownership, while there are only 170 cases (36.2 percent) where A-players tried to sell their ownership stake to B. If they offered to sell, these offers were accepted in 118 cases (69.4 percent) and rejected in 52 cases (30.6 percent). Figure 1 depicts the fractions of contractual choices over time and shows that there is no time trend in the data.

Insert Figure 1 here

This choice behavior is a clear contradiction of the self-interest model which predicts that B ownership should be chosen because it supposedly induces more efficient investment behavior. In order to understand this result we have to analyze the actual investment behavior of the two players depending on whether joint ownership or B-ownership prevailed.

Consider first the cases where A-players chose to stick to joint ownership. Under joint ownership 60 percent of all B-players (180 of 300) chose the efficient investment level $b = 10$ at stage 1. Only 41 B-players (13.7 percent) chose the minimum investment level $b=1$. On average, B-players invested 7.7. This is in sharp contrast to the prediction of the self-interest model that implies that B-players should not invest.

However, the high investment levels of B-players make sense if we look at the reaction of player A at stage 2. Even though it is a dominant strategy for a self-interested player A to choose $a=1$ under joint ownership no matter what investment level has been chosen by player B, many A-players reciprocated to high investment levels of player B by choosing a high investment level themselves. This is illustrated in Figure 2 which shows the average investment level of player A at stage 2 given player B's investment b at stage 1.[9] Clearly, there is strong reciprocity in A's investment.

Insert Figure 2 here

[9] The average investment level of player A over all cases of joint ownership is 6.7.

Table 1 reports on several regressions with the associated robust standard errors that try to explain A's investment behavior. The first one is a simple OLS regression of A's investment on B's investment. There is a very strong and highly significant relation between the two. An increase in B's investment level by one unit increases the expected investment level of A by 0.89. Thus, the expected marginal return of one additional unit of investment for player B is

$$\frac{1}{2}22(1+0.89)-12=8.79>0,$$

so if player B maximizes his expected monetary income, it is indeed optimal to choose *b=10*.

Insert Table 1 here

Regression (1) ignores the fact that the observed investment levels of the A-players are not independent of each other because we observed each A-player several times. Therefore, in regression (2) we treated the observations of each individual A-player as separate clusters. Here the standard errors are based on the assumption that the investment levels are independent across different A-players but we allow for dependent observations within each cluster (i.e. for all observations belonging to one A-player). The assumption that investments are independent across A-players is reasonable because an A-player could never observe what other A-players did.[10] The regression shows that the impact of *b* on *a* is still highly significant.

Regressions (3) and (4) include an additional variable $D1 \cdot a^*$, where D is a dummy variable with

$$D1=\begin{cases}1 & if \quad b \geq b^* \\ 0 & if \quad b < b^*\end{cases}$$

The idea is that if B invests at least as much as A suggested ($b \geq b^*$), then A may feel obliged to honor her announced investment level *a**. The coefficient for D1×astar suggests that there is a 42 percent chance that A honors her announcement if B invested at least *b**.

Insert Table 2 here

[10] To check the robustness of our results we also conducted Tobit regressions. All variables that are significant in the OLS regressions are also significant in the Tobit regression.

Although A-players respond, on average, quite strongly to increases in the investment level of player B, it is important to notice that there are big differences in individual behavior. A closer look at the data reveals that not all A-players reciprocated. This can be seen from Table 2 which shows the distribution of investment pairs (a,b). Note that 218 out of 300 (72.7 percent) investment choices of A are on the diagonal, i.e., given b player A has chosen $a=b$. If we exclude the 37 cases with $a=b=1$, we still have 60.3 percent of reciprocal investment choices of A-players. Only 9 times did an A-player invest more than B, but there are 73 cases (24.3 percent) where $a<b$, and in 85 cases $a=1$ which is the dominant strategy of a self-interested player A. Thus, there is a significant minority of A-players who seem to behave selfishly.

> ***Result 2:*** Under joint ownership there is, on average, strong reciprocity of A given B's investment. A-players can be separated in two types:
>
> - Fair types choose $a=b$ (at least 60 percent)
> - Selfish types choose $a<b$ (at least 20 percent)
>
> The majority of B-players (60 percent) trusted that A is going to reciprocate and chose $b=10$.

Consider now the 170 out of 470 cases (36.2 percent) where A tried to sell her ownership stake to B. The first question is why these offers got rejected so often (in 52 cases, i.e. 30.6 percent of all offers). The average price of the rejected offers was 176.9, while the average price of the accepted offers was just 120.8.[11] If the seller accepts the offer T and invests *b=10* himself while A invest *a=1* (which are the dominant strategies for self-interested players if B becomes the sole owner), then B's payoff is $M^B = 22(10+1) - 12 \cdot 10 - t = 122 - t$. Thus, accepting a price offer that is larger than 122 pays off only if B expects A to invest considerably more than $a=1$. Given that A sold her ownership stake this seems unlikely. In fact, A invested $a=1$ in 85 out of the 118 cases (72 percent) where she sold her ownership stake successfully to B, and her average investment level in these cases was just 1.9. Virtually all B-players (111 out of 118) chose $b=10$.

[11] In fact, a Mann-Whitney Test confirms that the differences between the accepted and rejected offers are highly statistically significant (p=0.0000).

Consider now the payoffs of the two players under the different ownership structures. Under joint ownership, A's average income is 77.5, while B made on average 66.4. If A tried to sell her ownership stake to B, average payoffs are 67.9 and 12.8 respectively. Thus, it turns out that the payoff difference between A and B is fairly small (but statistically significant) under joint ownership, but very large if A offered her ownership stake for sale. Furthermore, joint ownership Pareto-dominates B-ownership. Figure 3 shows that in all periods (except for period 1) both players were better off with joint ownership than with B-ownership. These differences are also statistically significant.[12]

Insert Figure 3 here

> ***Result 3:*** *In JOD, joint ownership is the more efficient allocation of ownership rights. Both players receive a higher average payoff if A decides to stick to joint ownership rather than to sell her ownership rights to B. A purely self-interested player A should opt for joint ownership.*

IV.B A-Ownership Design

We now turn to the results of the A-ownership design where A-players could choose between sticking to A-ownership or giving away for free half of the revenues of the project to the other player. We observed a total of 230 contractual choices in sessions S5 and S6.

> ***Result 4:*** *The overwhelming majority of A-players chose to make B the joint owner of the project. There is no significant time trend. If anything, the share of joint ownership is increasing over time.*

In total, joint ownership was chosen in 81.3 percent of all contractual offers (187 of 230 observations). The time path of choices is depicted in Figure 4.

Insert Figure 4 here

[12] A Mean-Whitney test shows that A's payoff under joint ownership is significantly larger than B's payoff under joint ownership (p=0.0003) and is also significantly larger than A's payoff if she tried to sell her ownership stake to B (p=0.0001).

If there is joint ownership, the investment behavior is very similar to the investment behavior under joint ownership in the JOD: 135 out of 187 B-players (72.2 percent) choose $b = 10$. The majority of A-players reciprocated to B's investment choices.

Insert Table 3 here

The regressions reported in Table 3 have the same structure as the regressions of Table 1 and yield very similar results. On average, B invested $b = 8.9$ while A invested $a = 6.5$ as compared to $b = 7.7$ and $a = 6.7$ when A decided to stick to joint ownership in the JOD. This indicates that if A gives away half of the firm for free, this induces more reciprocal investments of B than if A just decides to stick to joint ownership.[13] The following table shows the distribution of investment pairs (a,b).

Insert Table 4 here

117 out of 187 (63 percent) investment choices of A are on the diagonal, i.e., player A chose $a = b$. If we exclude the 9 cases where $a = b = 1$, we still have 57.8 percent of reciprocal investment choices of A-players. Only once did an A player invest more than B, but there are 69 cases (37 percent) where we observe $a < b$, and in 49 of them $a = 1$ which is the dominant strategy of a self-interested player A. Thus, there is a strong minority of A-players who behave selfishly. Nevertheless, most players B seem to have anticipated reciprocal behavior: 135 out of 187 (72 percent) chose $b = 10$, while only 10 (5,3 percent) chose an investment level of 1 or 2.

Result 5: Under joint ownership there is, on average, strong reciprocity of A given B's investment. A-players can be separated in two types:

- Fair types choose $a = b$ (at least 55 percent)
- Selfish types choose $a < b$ (at least 35 percent)

The majority of B-players (more than 70 percent) trusted that A is going to reciprocate and chose $b = 10$.

[13] In fact, a Mean-Whitney test shows that the distribution of *b* under joint ownership differs significantly in the AOD from the JOD (p=0.0004).

In 43 out of 230 cases (18,7 percent) A decided to stick to A-ownership and to hire B as an employee. B-players rejected the wage offers 5 times. The average wage offer was 62.05. Under A-ownership almost all B-players chose the minimum effort level (average $b = 1.26$), while all A-players chose $a = 10$, which is a dominant strategy for both, self-interested and fair-minded types of A.

A's average income under joint ownership is 91.4, while it is only 55.0 if she chose to stick to A-ownership. B's average income under joint ownership is 62.9, while he received only 44.5 if A tried to hire him as an employee.[14] Thus, the following result is very similar to Result 3 of JOD.

Result 6: *In AOD, joint ownership is the more efficient allocation of ownership rights. Both players receive a higher average payoff if A decides to give away half of the project to player B rather than to hire B as an employee. A purely self-interested player A should opt for joint ownership.*

While this result is again inconsistent with the self-interest model, it confirms the prediction of Grossman and Hart (1986) that parties will always try to achieve the most efficient ownership structure. Our results show that independent of whether the parties start from joint ownership or from A-ownership, they will always end up with joint ownership which turns out to be the most efficient ownership structure.

IV.C Control Treatment for Joint Ownership Design (JOD')

In Session S7 and S8 we conducted a control treatment of the Joint Ownership Design in which the parties also started from joint ownership, but this time the game did not end after B rejected A's offer. Instead the game continued with joint ownership as if no offer had been made. We have a total of 240 observations for this treatment. Again, joint ownership prevailed in the majority of cases (196 of 240 observations, 81.7 percent). However, this time A-players tried to sell their ownership stake more often (in 134 out of 240 cases, 55.8 percent). It seems that making an offer was considered to be less risky by A-players because if the offer got rejected the parties would just get back to the status quo of joint ownership. In

[14] Even if we only consider those cases where B accepted A's wage offer, both parties receive a lower payoff than under joint ownership (A: 62.2, B: 50.4).

fact, the offers got rejected considerably more often (in 90 out of 134 cases, 67.2 percent). Let us consider the three different possibilities in turn:

- If A did not make an offer, the investment behavior is very similar to the investment behavior in the other designs when joint ownership prevailed. B-players invested on average $b = 7.0$, while A-players invested on average $a = 6.1$. The reciprocal behavior of A-players is virtually identical to the one that we observed under joint ownership in JOD and AOD.

- If A did make an offer that was accepted by B-players, the investment behavior is very similar to the corresponding case in the JOD. Almost all B-players invested efficiently ($b = 9.5$ on average), while almost all A-players chose the minimum investment level ($a = 1.2$ on average). However, it is interesting to note that the average price of the accepted offers was much lower than the average accepted price in the JOD ($T = 88.9$ as compared to $T = 120.8$). This reflects the fact that B's threat point payoff if he rejected the offer was not zero but to go back to the status quo of joint ownership. In fact, B's average payoff after accepting A's offer is 31.4 which is significantly larger than the 18.5 that he received on average when he accepted A's offer in the original JOD.

- Two thirds of all offers made by A-players got rejected. The average price of the rejected offers was 161.4, again somewhat lower than the average price of rejected offers in the original JOD (176.9), but still very high. After the offer was rejected the two players played the investment game under joint ownership. In these cases B invested only $b = 6.3$ while A invested only 3.9 on average which seems to be much less than the investment levels under joint ownership in JOD or AOD. The following regression confirms that there is a significant difference in A's investment behavior depending on whether she initially tried to sell her ownership stake (and got rejected) or not. Here, D2 is a dummy variable that is equal to 0 if joint ownership prevailed because A's offer to sell was rejected and equal to 1 if A decided to stick to joint ownership voluntarily. The regression shows that if A's sales offer got rejected, she reciprocates significantly less.

Insert Table 5 here

This is also reflected by the fact that the fraction of A-players who chose $a = 1$ independently of the investment level of player B is much larger if A's offer got rejected: 54 out of 90 A-players (60 percent) chose the minimum investment level. B-players seem to have anticipated this behavior, and only 40 out of 90 (44.4 percent) opted for the efficient investment level $b = 10$.[15] Thus, the fact that A-players tried to sell their ownership stake to B was interpreted by B-players as a signal that it is less likely that they face a fair-minded A-player, and this expectation turned out to be correct.

V Theoretical Predictions

The predictions of the property rights approach and the self-interest model can be summarized as follows:

Proposition 1: *If both parties are only interested in maximizing their own material payoff, then*

1. *A and B-ownership are equally efficient and more efficient than joint ownership and*
2. *no matter what the initial allocation of ownership rights, the parties will trade ownership rights ex ante so as to set up the efficient ownership structure and to implement the second best optimal investment decisions.*

The first prediction is clearly refuted by the experimental results which have shown that joint ownership is far more efficient than A- or B-ownership in all three treatments. However, the second prediction is largely confirmed by the experiments. In the large majority of all cases parties agreed on the more efficient joint ownership arrangement ex ante, no matter whether they started from A-ownership or from joint ownership.

In this section we want to discuss whether theories of fairness and reciprocity are consistent with the experimental results. There are several recent theories that try to capture concerns for fairness and/or reciprocity on individual decision making. Some of the proposed models, in particular Rabin (1993) and Dufwenberg and Kirchsteiger (2004), adopt the concept of "psychological game theory" that had been introduced by Geanakoplos, Pearce and

[15] A Mean-Whitney test confirms that the distribution of *b* under joint ownership is significantly different if A chose joint ownership as compared to if B rejected A's offer (p=0.0000).

Stacchetti (1989) in order to model "intention-based reciprocity". In these models players have beliefs not just about the actions of their opponents but also about their intentions. They are willing to reward kind and to punish unkind intentions. While these models convey many interesting insights, they are complicated and often difficult to use in applications. Furthermore, they are often plagued by multiple equilibria. Fehr and Schmidt (1999) and Bolton and Ockenfels (2000) follow a different approach. They assume that players care only about outcomes (and not about intentions), but that they have "social preferences" in the sense that they dislike inequitable allocations. These models do not capture "reciprocity" in the intension-based sense, but rather "distributional fairness" or "inequity aversion". These models use standard game theoretic tools and it is straightforward to apply them to any game. Furthermore, Fehr and Schmidt (1999) and Bolton and Ockenfels (2000) show that their models are able to explain not just the qualitative, but also the quantitative results of many classes of experimental games fairly well.[16]

It turns out that models of intensions-based reciprocity give rise to the same predictions as models of social preferences if it is assumed that *everybody* is strongly concerned about fairness. However, the Fehr and Schmidt (1999) model acknowledges that people differ and that only some people care about fairness while others behave rather selfishly. Furthermore, the model allows for incomplete information about which type of player the opponent is. With heterogeneous agents the interaction between fair and self-interested types comes into play and gives rise to quite different predictions. In the rest of this section we will analyze these two cases in more detail.

V.A Homogeneous fair agents

Consider first the case where all parties strongly care about fairness and/or reciprocity. In this case models of intention-based reciprocity and of models of inequity aversion yield the same predictions in the context of the simple game under consideration here.

To see this consider the case of joint ownership first. If players are concerned about intentions, then a low investment level of player B will be interpreted as a hostile action that A wants to punish by choosing a low investment level herself, while a high level of b will be interpreted as a kind action that is rewarded by a high level of a. Anticipating this, player B

[16] There are also a few models that try to model preferences for fair outcomes and fair intentions simultaneously, in particular Falk and Fischbacher (2000) and Charness and Rabin (2002). These models are more general, because they combine social preferences and intention based reciprocity, but they are even less tractable for applications and again plagued by multiple equilibria. See Camerer (2003) and Fehr and Schmidt (2003) for extensive surveys and critical discussions of this literature.

will choose the efficient investment level *b** at stage 1, and A will reciprocate by choosing $a = a^*$. If players are inequity averse, then player A will also match B's investment level and choose *a(b)=b*, not because she cares about intentions, but because this equalizes final payoffs. Anticipating this, player B will again invest efficiently at stage 1. Thus both approaches imply that joint ownership implements first best investments.

What about A-ownership? At stage 2, A's investment decision does not affect B's payoff, because B gets a fixed wage anyway. Therefore, models of intention based reciprocity predict that A will just maximize her own payoff, i.e. choose the efficient investment level *a=10*. If player A has social preferences and dislikes inequality, she will also invest efficiently. To see this, we have to distinguish two cases depending on the fixed wage *w* that B receives. Either *w* is sufficiently large so that B is better off than A. In this case A wants to reduce the payoff difference by maximizing her own monetary payoff which requires that she invests efficiently. Or *w* is such that A is better off than B. In this case A may want to reduce the payoff difference by investing $a < a^*(b)$. However, if we assume with Fehr and Schmidt (1999) that A prefers to get one additional Dollar for herself rather than to throw this Dollar away in order to reduce the inequality towards B[17], she will invest efficiently.

At stage 1, B's investment *b* depends on the wage that A offered to him at stage *0*. If *w* is small, B will choose a low investment level. In a model of intension based reciprocity he will do so in order to punish A for her unkind offer. In a model of inequity aversion he will choose a low investment level in order to reduce the payoff difference between himself and A. On the other hand, if A offered a generous wage at date 0 that gives $w = 1/2 \cdot v(a^*, b^*)$ to B, then B will choose the efficient investment level *b**, either because he wants to reward A for her generous offer or because he wants to increase A's payoff in order to reduce the inequality that is now to his advantage. Thus, at stage 0, a fair player A will make this generous wage offer that equalizes payoffs, and both parties will choose the efficient investment levels *a** and *b**, respectively.[18] The analysis of B-ownership is analogous to the case of A-ownership.

Proposition 2: *If both parties are strongly concerned about either distributional fairness or intention-based reciprocity, then the ownership*

[17] I.e., $\beta < 1$. See Section III.C below.

[18] It has to be noted that this equilibrium is unique if players have social preferences, but that there are other equilibria if players care about the intentions of their opponents. For example, it is also an equilibrium that A offers a low wage because she beliefs that player B will be hostile and choose a low investment level. In equilibrium these beliefs are self-fulfilling.

structure is irrelevant. Both parties will invest efficiently no matter whether there is joint, A-, or B-ownership.

Thus, if fairness and reciprocity are common knowledge, then they induce both parties to invest efficiently even if investments cannot be contracted upon. Reciprocal fairness suffices as an enforcement device, and the allocation of ownership rights does not play a role. However, like the self-interest model, this prediction is in stark contrast to the experimental evidence.

V.B Interaction of self-interested and fair players

We will now consider the case where some people are strongly concerned about fairness while other people are mainly self-interested. Furthermore, we will assume that people don't know whether they face a fair and trustworthy opponent or whether their opponent is going to exploit them. This case of heterogeneous agents and incomplete information is considerably more difficult to analyze with models of intention based reciprocity. However, the Fehr-Schmidt (1999) model of inequity aversion takes the distribution of preferences and incomplete information explicitly into account and allows to analyze the game with incomplete information in a fairly straightforward manner. Therefore, in the following we will focus on the model of inequity aversion. However, we would like to stress that we do not regard our experiments as a test of this particular model against other models of fairness.

The theory of Fehr and Schmidt (1999) has two main ingredients: First, it assumes that some people are not only concerned about their own material payoff but also care about inequity or, in our context, inequality.[19] Second, the theory acknowledges that people differ. Some people are very much concerned about inequality and have a high willingness to pay in order to reduce it, while others only care about their own material payoff. In the two-player case the utility function of inequity averse (fair) players is given by

$$U_i(x) = x_i - \alpha_i \cdot \max\left\{x_j - x_i, 0\right\} - \beta_i \cdot \max\left\{x_i - x_j, 0\right\},$$

$i \in \{1,2\}$, $i \neq j$, where $x = (x_1, x_2)$ denotes the vector of monetary payoffs, $\beta_i \leq \alpha_i$ and $0 \leq \beta_i < 1$. In this utility function, the term weighted with α_i measures the utility loss that

[19]Fairness implies that equals should be treated equally. In our experiments, the subjects enter the laboratory as equals. They have no information about their opponents and do not know with whom they trade. Thus, in these very simple environments, it seems natural to define *equality* as the reference point for a fair payoff distribution.

stems from inequality to i's disadvantage, while the term weighted with β_i measures the loss from advantageous inequality.

We use a simplified version of this theory. Following Fehr and Schmidt (1999) we assume that there are 60 percent self-interested types ($\alpha_i = \beta_i = 0$) and 40 percent "fair" types. We assume that fair subjects exhibit $\alpha_i = 2$ and $0.5 < \beta_i < 1$. Thus, if the inequality is to their disadvantage, they are prepared to engage in costly "punishment" in order to reduce the payoff of their opponent. On the other hand, if the inequality is to their advantage, they are willing to spend resources in order to benefit the other player. Note that subjects with $1 \geq \beta_i > 0.5$ and $\alpha_i = 2$ and are willing to share the surplus of a contract equally but also to reject offers that give them less than 25 percent of the surplus. Fehr and Schmidt demonstrated that the evidence from many experiments is roughly compatible with the assumption that 40 percent of all subjects fall in this category.[20]

On the basis of these assumptions, the property rights game can be analyzed using standard game theoretic tools. The full analysis is not difficult but somewhat lengthy and is therefore relegated to an appendix that can be found on our webpage.[21] In the following, we report the main predictions for our experiments and give the intuition for them.

V.B.1 Analysis of the Joint Ownership Design

With asymmetric information about whether the opponent is self-interested or fair-minded, the contract offer made at stage 0 may signal some information about A's type. Therefore, let *p* denote the (endogenously determined) probability assigned by B to the event that he faces the self-interested type of player A.

Consider first the case where A chooses to stick to joint ownership at date 0. At date 2, a self-interested type of A chooses *a=1* while a fair-minded type of A chooses *a=b*. At date 1, anticipating A's reaction, the self-interested type of B chooses *b=10* if he believes that it is sufficiently likely that he faces a fair-minded player A, i.e. if p is sufficiently small ($p < \frac{10}{11} = 0.91$). Otherwise he chooses *b=1*. The fair-minded type of B, on the other hand,

[20] See Fehr and Schmidt (1999) for a more extensive discussion of the experimental evidence on the distribution of inequity averse types. When they calibrated their model to explain the quantitative evidence in the different games they used four different types, but aggregated they also have that 40 percent of subjects exhibit $\alpha_i \geq \beta_i > 0.5$ and that 60 percent exhibit $0.5 > \alpha_i \geq \beta_i$.

[21] Please visit: http://www.vwl.uni-muenchen.de/ls_schmidt/experiments/property_rights/index.htm .

will be more careful, because he suffers not only the monetary loss if player A does not reciprocate, he also suffers from the inequity that is generated if he invests while A does not. Therefore, the fair-minded type of B will invest only if $p < \frac{10}{35} = 0.29$. This result is surprising. It says that if there is uncertainty about A's type, then a self-interested player B *is more likely to invest* than the fair-minded type of B.

Consider now the case where A sold his ownership stake to B at price *t*, so B is the sole owner of the project and full residual claimant on profits. In this case it is a dominant strategy for both types of B to choose $b = 10$ at date 1. The intuition is simply that with B-ownership B's investment does not affect A's payoff, so B cannot increase A's payoff by investing less than the efficient amount. At stage 2, the self-interest type of A chooses again a=1. The fair-minded type of A will invest in order to reduce the inequality between herself and B, but only if she sold her ownership stake at a sufficiently high price to B. In fact, she chooses the efficient investment level if and only if $t \geq 220$.

We now turn to the analysis of the entire game. First, we can rule out the possibility of a separating equilibrium in which the self-interested type of A chooses one type of contract with probability 1 and the fair-minded type of A chooses another type.

Lemma 1: *There does not exist a separating equilibrium.*

The intuition is that the selfish type of A would always want to mimic the fair type: Suppose that the selfish type of A sells her ownership stake while the fair type chooses to stick to joint ownership. Then B would invest 10 under joint ownership which induces the selfish type of A to deviate and to stick to joint ownership as well. So suppose that the selfish type of A sticks to joint ownership while the fair-minded type offers to sell. In this case B would choose b=1 if he is offered joint ownership, so the selfish type of A is better off by selling his ownership share, a contradiction.

In the game under consideration here it seems very plausible that sticking to joint ownership will not be interpreted as a signal that player A is selfish. This is captured by the following condition:

Condition 1: *If A chooses to stick to joint ownership, then B's updated belief that he faces the self-interested type of A does not increase.*

This condition implies that the game has a unique Perfect Bayesian Equilibrium:

Proposition 3 [Joint Ownership Design]: *With incomplete information about the players' types there exists a unique Perfect Bayesian Equilibrium outcome satisfying Condition 1. The equilibrium is a pooling equilibrium in which both types of A stick to joint ownership.*

- *The self-interested type of B chooses* $b^s = 10$*, while the fair-minded type of B chooses* $b^f = 1$*. The self-interested type of A chooses* $a^s = 1$ *and the fair-minded type of A chooses* $a^f = b$ *in equilibrium.*
- *Expected monetary payoffs are* $M^{As} = 69.4$ *for the self-interested type of A and* $M^{Af} = 64$ *for the fair-minded type of A, so the average monetary payoff of A is* $M^A = 67.24$*. The expected monetary payoff of the self-interested type of B is* $M^{Bs} = 40.6$ *and of the fair-minded type of B is* $M^{Bf} = 10$*, so in expectation* $M^B = 28.36$.

Note that Proposition 3 differs sharply from Propositions 1 and 2. Proposition 1 assumed that it is common knowledge that all players are self-interested. In this case no ownership structure implements first-best investments, but A- and B-ownership are strictly better than joint ownership. Proposition 2 assumed that all players are fair-minded. In this case any allocation of ownership rights implements first-best investment decisions and the allocation of ownership rights is indeterminate. With incomplete information about the players' types, Proposition 3 shows, like Proposition 1, that first-best investments cannot be implemented, but that there is a second-best allocation of ownership rights that will obtain in equilibrium. However, this time joint ownership is optimal. Proposition 3 predicts that in equilibrium player B invests efficiently only if he is self-interested. If he is fair-minded, he prefers not to invest in order to reduce the inequality that arises if he is matched with a selfish player A. Player A invests efficiently only if she is fair-minded and if she is matched with a B-player who invested $b = 10$.

In the control treatment *JOD'* the game did not end when A offered to sell her share and B rejected this offer. Instead, the game continued with joint ownership. This improves B's threatpoint payoff when A chooses to make an offer which makes it less attractive for A to sell her share to B. On the other hand, it is less risky for A to make an offer, because if her offer gets rejected, the parties are just back to joint ownership. Nevertheless, it is shown in the Appendix that Proposition 3 still applies on the equilibrium path, so the prediction for this control experiment is exactly the same.

V.B.2 Analysis of the A-Ownership Design

In this design A is the sole owner of the project initially. At date 0 she can choose whether to remain the sole owner and to hire B as an employee at wage w, or whether to give away half of the project to B for free in which case there is joint ownership.

If A goes for joint ownership, the analysis is the same as the one of the last subsection. So suppose that she decides to stick to A-ownership and to hire B as an employee. As in the case of B-ownership above, at stage 2, it is a dominant strategy for the self-interested and the fair-minded owner to choose $a=10$. Consider now stage 1. Anticipating A's investment, the self-interested type of B clearly chooses $b=1$. The fair-minded type of B also chooses $b=1$ if his wage is sufficiently small ($w<67$). Otherwise he will choose b so as to equalize payoffs. This parallels the analysis of B-ownership in Section V.B.1 above.

Consider now stage 0. The self-interested type of B will accept the contract offered by A if and only if $w \geq 12$. The fair-minded type of B accepts any contract with $w \geq 56$. At stage 0, if the self-interested type of A offers $w = 12$, this will only be accepted by the self-interested type of B. If she offers $w = 56$ this will be accepted by both types of B, which yields a slightly higher payoff. It is easy to show that offering more than 56 reduces her payoff, so A will offer $w = 56$ which is accepted by both types of B. The fair-minded type of A wants to equalize payoffs and offers $w = 67$, which is also accepted by both types of B. Hence, the theory of inequity aversion predicts the same investment levels as the self-interest theory, but it differs in the prediction of the wages offered to B.

Let us now turn to the entire game. Again, if we are willing to impose a condition that parallels Condition 1, we get a unique equilibrium prediction.

Condition 1': *If A offers a joint ownership contract and gives away half of the revenues of the firm to B, then B's updated belief that he faces the self-interested type of A does not increase.*

Proposition 4 [A-Ownership Design]: *With incomplete information about the players types there exists a unique Perfect Bayesian Equilibrium outcome satisfying Condition 1'. The equilibrium is a pooling equilibrium in which both types of A offer a joint ownership contract which is accepted by both types of B. The equilibrium outcome is the same as under joint ownership described in Proposition 3.*

Thus, Propositions 3 and 4 predict that the players will always end up with joint ownership, no matter what the initial allocation of ownership rights. Joint ownership does not implement first best investment decisions. However, it still outperforms A- (or B-ownership). Under joint ownership *both* parties invest with a significant probability, while under A- (or B-)ownership only the owner invests while the other party does not. Furthermore, under A-ownership A has to hire B as an employee, and there is a significant probability that a fair-minded type of B will reject a wage offer that he perceives as unfair. Similarly, in the joint ownership design A has to sell her ownership stake to B and again there is some probability that this offer is going to be rejected. Therefore, the model of inequity aversion predicts that joint ownership is more efficient. This is in contrast to the self-interest model that predicts A-(or B-) ownership to be more efficient. However, both models support the Coase Theorem which suggests that the parties will adopt the ownership structure that is most efficient independent of the initial allocation of ownership rights.

V. Conclusions

In this paper we analyzed the problem of the optimal allocation of ownership rights under three different assumptions about people's preferences. First, the standard property rights approach assumes that all people are purely self-interested. In such a world, no ownership structure induces the parties to make efficient relationship specific investments. However, the allocation of ownership rights matters, because A- and B-ownership strongly outperform joint ownership. Second, if all people are strongly concerned about fairness or reciprocity, then under any ownership structure reciprocal fairness suffices as an enforcement device to induce all parties to invest efficiently. Thus, the allocation of ownership rights is irrelevant. Third, the model of inequity aversion assumes that some people are strongly fair-minded while others are mainly self-interested. This model focuses on the interaction between fair-minded and self-interested players and shows that fairness alone is not sufficient to induce first best investments and that the ownership structure does matter. However, in contrast to the property rights approach, it is joint ownership that turns out to be second-best optimal. The reason is that joint ownership makes better (but still imperfect) use of fairness as an implicit enforcement device.

The experimental results are largely consistent with the model of inequity aversion. People differ in their behavior. Joint ownership turns out to induce higher investment levels than A- (or B-) ownership and to generate higher payoffs for both parties. Furthermore, the experimental subjects seemed to understand this. They opted predominantly for joint ownership, independent of the initial ownership structure. This confirms the proposition of the Coase Theorem that the parties will always try to choose the efficient ownership structure ex ante.

In a recent paper, Oliver Hart (2001) argues that (a) "although norms are undoubtedly very important both inside and between firms, incorporating them into the theory has been very difficult and is likely to continue to be so in the near future" and (b) "a norm-free theory of the firm and a norm-rich theory of the firm don't seem to have very different predictions". He mainly looked at models of repeated games that try to capture norms or reciprocal behavior. In this paper we have shown that the recent advances in modeling fairness and reciprocity in one-shot games provide powerful tools to incorporate norms of fair or reciprocal behavior into contract theory. This allows us to derive important and testable predictions on the optimal allocation of ownership rights, some of which differ significantly from the standard predictions of the self-interest model. If we want to understand the incentive properties of real institutions on real people, concerns for fairness and reciprocity have to be taken into account.

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Figure 1: Share of joint ownership and B-ownership over time in the JOD

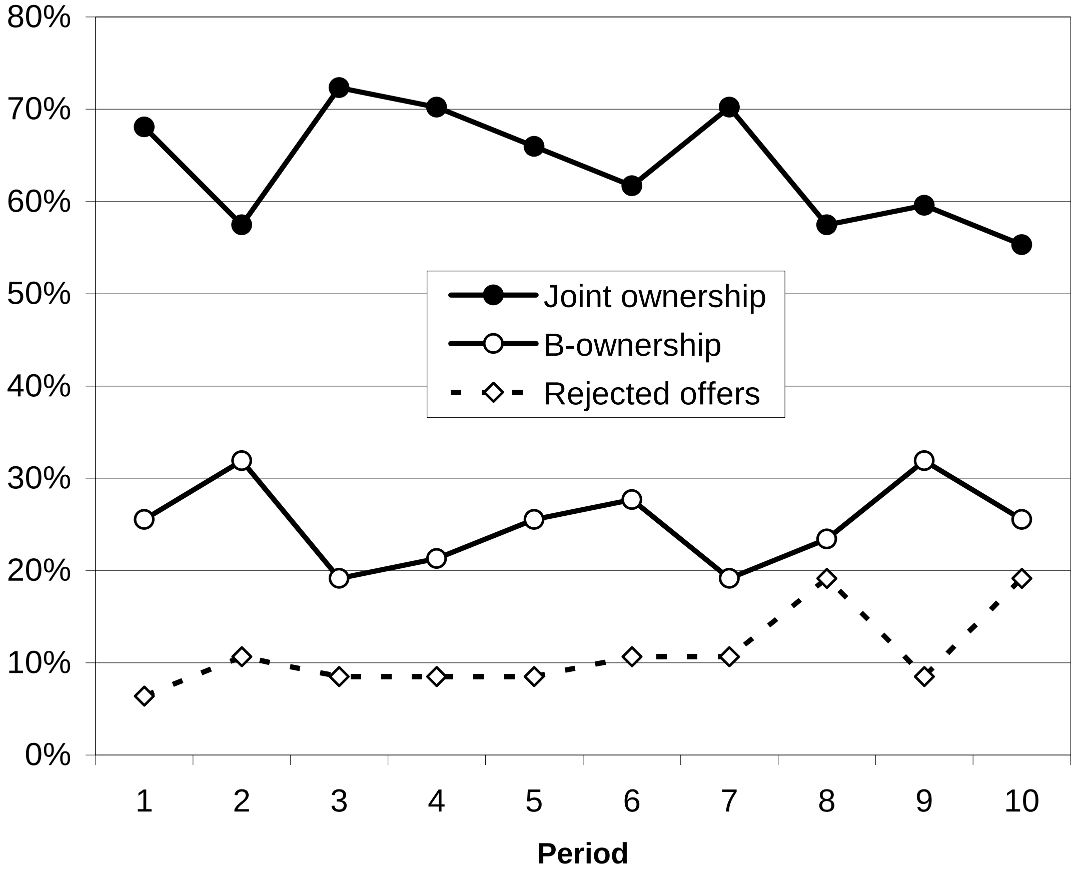

Figure 2: A’s average investment given b under joint ownership (JOD)

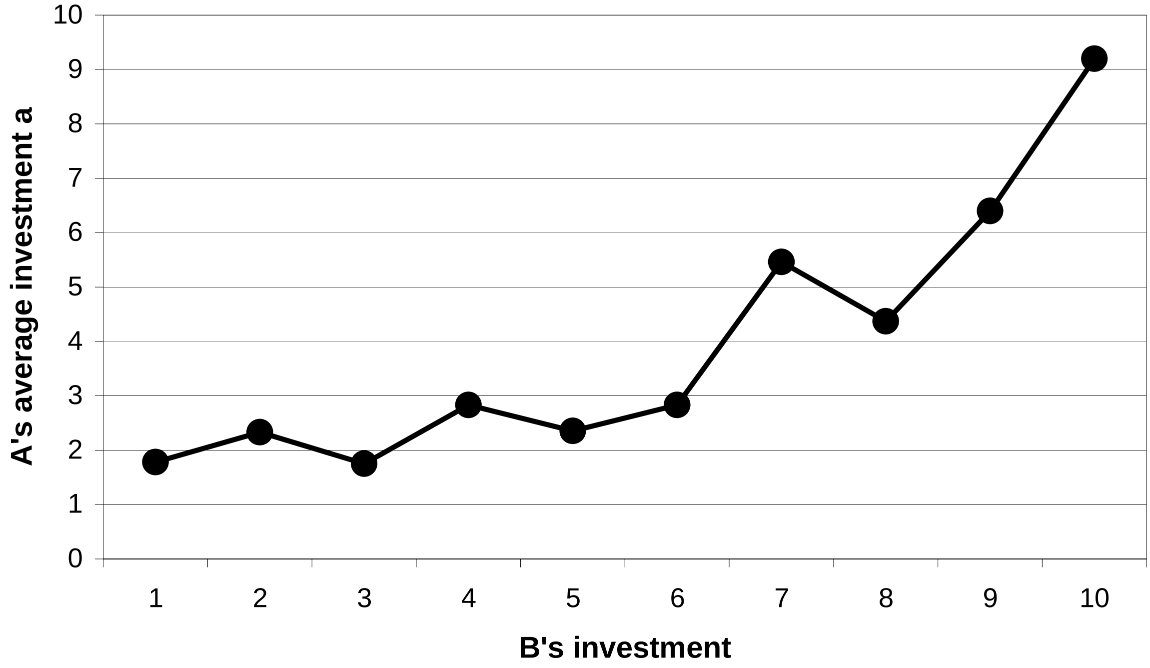

Figure 3: Payoffs over time under joint ownership and B-ownership (JOD)

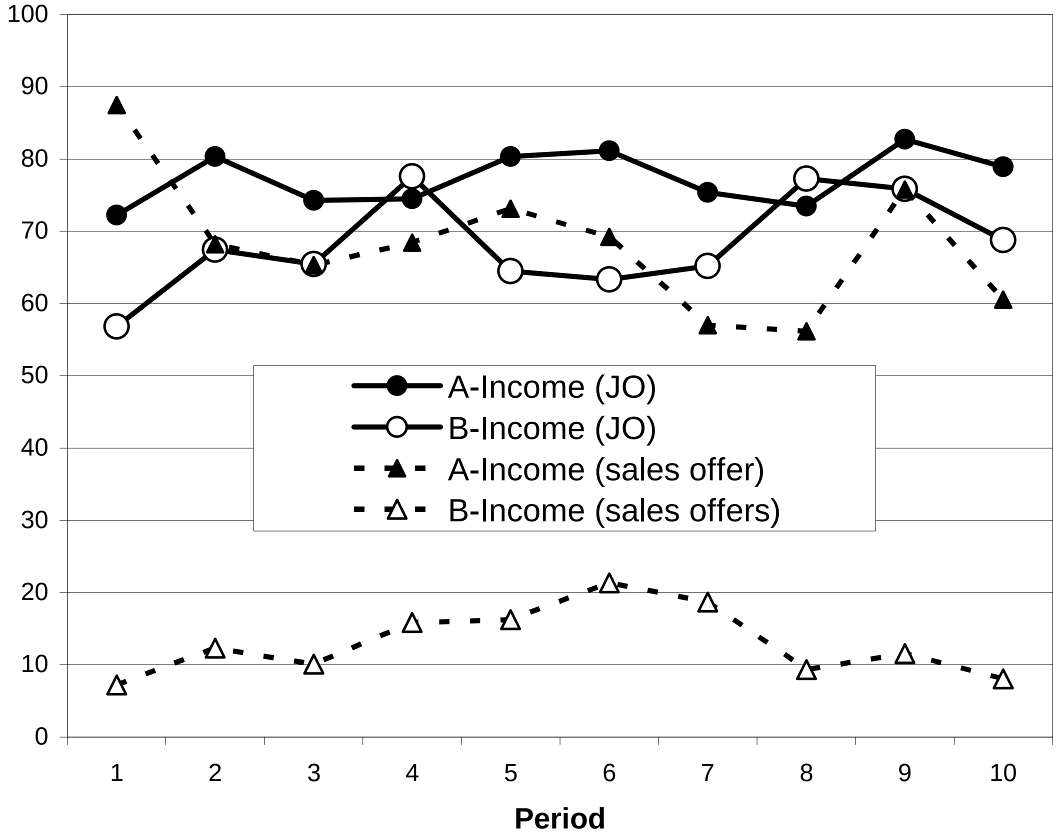

Figure 4: Share of joint ownership and A-ownership over time in the AOD

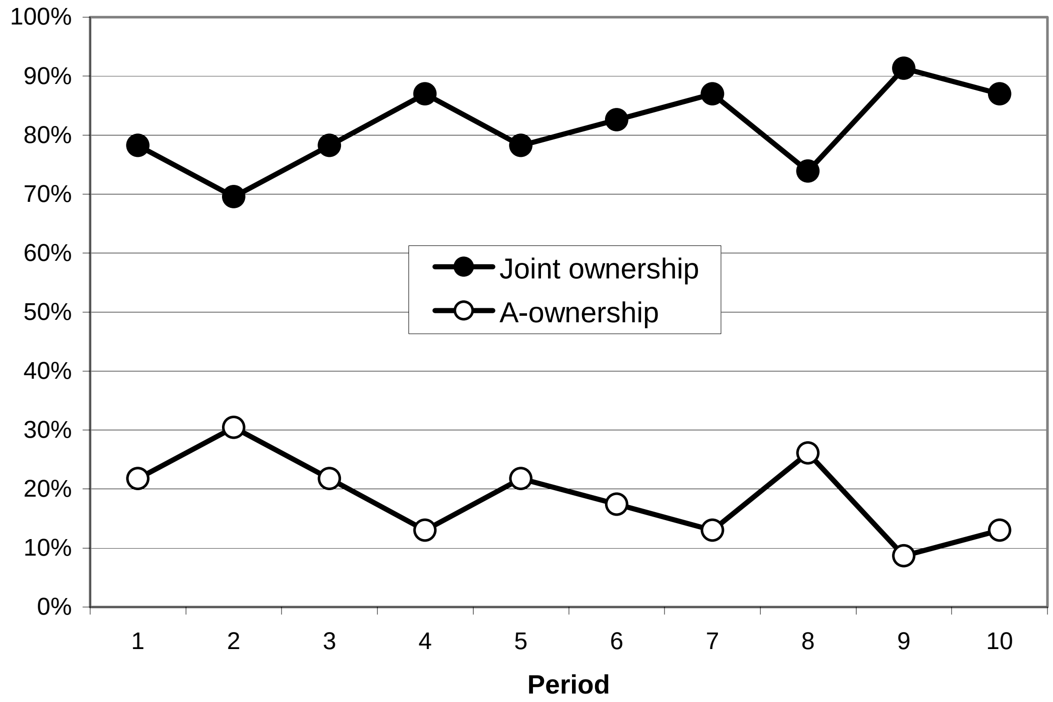

Table 1: Player A's investment as a function of player B's investment

Dependent variable: A's investment *a*	(1) (robust standard errors)	(2) (robust standard errors & clusters)	(1) (robust standard errors)	(2) (robust standard errors & clusters)
Const	-0.11 (0.38)	-011 (0.83)	1.14*** (0.43)	1.14 (0.82)
B	0.89*** (0.04)	0.89*** (0.09)	0.38*** (0.11)	0.38*** (0.14)
D1×astar			0.42*** (0.08)	0.42*** (0.08)
No. of observations	300	300	300	300
Adjusted R^2	0.57	0.57	0.62	0.62

Table reports the coefficients of OLS regressions. Robust standard errors are in parentheses. ***, ** and * indicate significance at the 1%, 5% and 10% level, respectively.

Table 2: Investments *(b,a)* with joint ownership contracts in JOD

b/ a	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	Σ
1	37					1				3	41
2	5	3								1	9
3	2	1	1								4
4	3	1		1				1			6
5	10	1		2	4						17
6	7	1				3	1				12
7	3				1	3	5			1	13
8	4					1	1	1		1	8
9	3						1		6		10
10	11	1			3	3	1	2	2	157	180
Σ	85	8	1	3	8	11	9	4	8	163	300

Table 3: Player A's investment as a function of B's investment (AOD)

Dependent variable: A's investment *a*	(1) (robust standard errors)	(2) (robust standard errors & clusters)	(1) (robust standard errors)	(2) (robust standard errors & clusters)
Const	-0.70 (0.51)	-0.70 (0.54)	0.32 (0.46)	0.32 ()
b	0.81*** (0.07)	0.81*** (0.10)	0.52*** (0.12)	0.52*** (0.12)
D1×astar			0.21** (0.10)	0.21** (0.09)
No. of observations	187	187	187	187
R-squared	0.21	0.21	0.22	0.22

Table reports the coefficients of OLS regressions. Robust standard errors are in parentheses. ***, ** and * indicate significance at the 1%, 5% and 10% level, respectively.

Table 4: Investments *(b,a)* with joint ownership contracts in AOD

b / a	1	2	3	4	5	6	7	8	9	10	Σ
1	9										9
2	1										1
3											0
4				1							1
5	3	1		1	2						7
6	2					1				1	4
7	5	1	1				3				10
8	2			1	1	1		4			9
9	3						1	2	5		11
10	33	2			2		1	1	4	92	135
Σ	58	4	1	3	5	2	5	7	9	93	187

Table 5: Player A's investment as a function of B's investment (JOD')

Dependent variable: A's investment *a*	(1) (robust standard errors)	(2) (robust standard errors & clusters)	(3) (robust standard errors)	(4) (robust standard errors & clusters)
Const	0.16 (0.17)	0.16 ()	0.20 (0.17)	0.20 ()
b	0.74*** (0.05)	0.74*** (0.08)	0.58*** (0.07)	0.58*** (0.12)
D2 × b			0.27*** (0.07)	0.27** (0.12)
No. of observations	196	196	196	196
R-squared	0.47	0.47	0.53	0.53

Table reports the coefficients of OLS regressions. Robust standard errors are in parentheses. ***, ** and * indicate significance at the 1%, 5% and 10% level, respectively.