Breach remedies, reliance and renegotiation

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Abstract

Breach remedies can be used to protect specific investments and are therefore a remedy against holdup. Yet some commonly used remedies are predicted to provide too much protection, thereby inducing overinvestment. Two motives drive this prediction: the *insurance* motive and the *separation prevention* motive. This paper presents results from an experiment designed to test whether these two motives show up in practice. In contrast to previous experiments the focus is on a setting where ex post renegotiations are possible. Our results indicate that also in this case the insurance motive and the separation prevention motive are at work, as predicted. A second main finding is that there is much less need for sophisticated breach remedies based on compensatory money damages than is suggested by theory. JEL codes: K12, J41, C91.

1 Introduction

When a party makes a relationship-specific investment, this investment is at risk because the other party may terminate the relationship. Anticipating that she may be unable to reap the full return, the investor will invest less than the efficient level. This is the well-known holdup underinvestment problem. This problem is considered to be of relevance in a wide variety of economic contexts (cf. Klein et al. 1978, Williamson 1985). For example, it provides the main ingredient for the property rights theory of the firm (see Hart 1995 for an overview).

To protect specific investments, parties may in advance agree on a contract that commits the breaching party to pay damages to the other party. Such

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remedies for breach of contract can take different forms, depending on exactly how the amount of damages is determined. We focus on the four most prominent types of breach remedies (cf. Posner 1977):

- liquidated damages: the breacher has to pay a fixed amount to the victim of breach. The amount to be paid is specified in the initial contract;
- expectation damages: the breacher has to pay the amount that makes the victim equally well off as under contract performance;
- reliance damages: the breacher compensates the victim such that the latter is equally well off as before the contract had been signed;
- specific performance: breach of contract is not possible. An agent is required to stay in the relation if the other party asks him to do so.

The theoretical literature predicts that breach remedies typically provide too much protection, thereby causing overreliance.[1] Two motives drive such overinvestment. First, with the exception of liquidated damages, the above breach remedies effectively insure the investor against separation. She still gets some private return on the investment made, even when it is efficient for the parties to separate and the specific investment has no social return. This is the *insurance motive*. The second motive to overinvest is only operative under reliance damages. In this case the investor is better off when the parties trade than when they efficiently separate. She may therefore have an incentive to reduce the probability of separation by investing too much. This is the *separation prevention motive*.

The theoretical predictions concerning overreliance hold irrespective of whether the initial contract can be renegotiated ex post, or not; see Rogerson (1984) and Shavell (1980), respectively. In an earlier experiment Sloof et al. (2003) establish the working of the two overinvestment motives in a setting without renegotiation. That paper serves as point of departure for the present one. In particular, in this paper we extend the experiment of Sloof et al. by allowing for ex post renegotiation. This makes the experimental setting much more realistic (see below).

The timing of events in the game that we study is represented in Figure 1. The game relates to a bilateral trading situation between a female Buyer and a male Seller over one unit of a particular good. At time 0 the parties sign a contract that specifies a fixed price at which they will trade. This fixed price cannot be conditioned on Buyer's investment decision. Subsequently, at time 1, Buyer makes an investment that increases her valuation of the good. Afterwards, at time 2, the parties learn for how much Seller can sell his unit to an alternative buyer. When this outside bid is known, Seller decides at time 3 whether to stick to the initial contract and to sell his unit to Buyer, or to breach the contract.

[1]Within the law and economics literature, specific investments are usually referred to as reliance expenditures. In this paper we use the terms investment and reliance interchangeably.

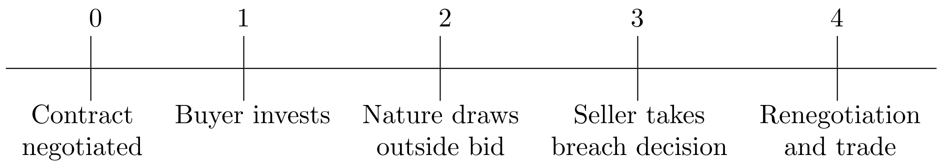


Figure 1: Timing of events in the holdup game

When Seller decides to breach, he has to pay damages to Buyer. In either case – after breach and after no breach –, Buyer and Seller have the opportunity to renegotiate at time 4 the terms of trade and separation, respectively.

The experiments reported in Sloof et al. (2003) capture stages 0-3, but omit stage 4.[2] The main findings are that observed investment levels closely follow the theoretical predictions. In case of expectation damages, the insurance motive indeed appears to be operative. In case of reliance damages, both the insurance and the separation prevention motive are at work, as predicted. The remedy of specific performance was not considered in this earlier study.

In the present experiment we add stage 4 to the game.[3] This enables us to test the theoretical prediction that adding a renegotiation stage does not affect (over-)investment incentives. This is important for two reasons. First, allowing for renegotiation is much more realistic. In practice it is highly unlikely that the interaction between the contracting parties ends with a breach decision when this decision results in an inefficient outcome. In case it appears ex post that parties can gain from renegotiation, they are likely to do so; parties typically cannot credibly commit not to renegotiate inefficient outcomes (cf. Edlin and Hermalin 2000). Second, it is well-known from both laboratory experiments and field data that renegotiations may cause substantial efficiency losses. Such losses are absent in theoretical models and, by construction, are also absent in Sloof et al. (2003). However, they may have a profound effect on investment incentives. One could for example reasonably expect less overinvestment, because some of the (social) returns on investment leak away in protracted bargaining.

The main findings of this paper are twofold. First, the two overinvestment motives are also present in the setup with ex post renegotiation, again causing overreliance. In line with theoretical predictions the insurance motive is present

[2]In the actual design of the experiments the initial contract is pre-determined for the subjects, implying that the game they play also effectively omits stage 0. The same procedure is employed in the current paper, see below.

[3]Our ordering of stages 3 and 4 follows Che and Chung (1999). The reason for this is twofold. First, it makes the present experiment better comparable with the benchmark study of Sloof et al. (2003). Second, in practice parties typically cannot threat not to renegotiate inefficient outcomes (cf. Edlin and Hermalin 2000). Because the breach decision itself may result in an inefficient outcome, one therefore should allow for renegotiations after Seller's breach decision. A more elaborate justification for the particular timing we use is given in Appendix A.1.

under reliance damages, expectation damages and specific performance. And the separation prevention motive is indeed operative under reliance damages only. Together with the earlier results obtained for the no-renegotiation setup, our current findings reveal that the two overinvestment motives are very robust.

Second, our results suggest that there is no strong need for sophisticated breach remedies based on compensatory money damages. Realized efficiency is higher either in the absence of a contract or under specific performance, compared with the three remedies of liquidated damages, reliance damages and expectation damages.[4] In particular, when ex ante trade is likely to be efficient, none of these three remedies performs better than specific performance. In the opposite case where the probability of a high outside bid is high, breach remedies do not induce higher efficiency levels than under no contract. It thus appears that information about the probability distribution of outside opportunities is sufficient for implementing the 'best' contract, and that a simple contract will suffice.

The remainder of the paper is organized as follows. In Section 2 we discuss the basic setup of the experimental game and derive the equilibrium predictions for the three breach remedies based on compensatory money damages. Section 3 presents the experimental design, while Section 4 reports the results. In Section 5 we investigate what happens in the absence of sophisticated damage payments. In particular, we present the results for the two polar cases of no contract and specific performance. In both cases there is no breach decision stage, because in the absence of a contract there is simply no contract that can be breached while under specific performance breach is explicitly excluded. Section 6 compares all five different cases in terms of efficiency. The final section summarizes our main findings and concludes.

2 Sophisticated breach remedies

2.1 Basic setup of the model

In this subsection we provide a precise description of the game reflected in Figure 1. For ease of exposition this description is cast in terms of the specific parameter values that are used in the experiment. These correspond with the ones chosen in Sloof et al. (2003). Appendix A discusses a more general specification of the model and also formally derives the equilibrium predictions.

[4] The latter three remedies are labeled 'sophisticated', because their implementation relies on careful determination of the exact amount that has to be paid. The informational problems associated with this are given attention in the final section of the paper.

The sophisticated breach remedies correspond to an entitlement (to Seller's good) protected by a liability rule, while specific performance is equivalent to an entitlement protected by a property right. The literature on the protection of entitlements (see e.g. Bebchuk (2002) and Croson and Johnston (2000)) is thus closely related.

Two risk neutral parties, labeled Buyer and Seller, may trade one unit of a particular good. Before actual trade takes place, Buyer can make a specific investment I that increases her valuation of Seller's product. Production costs are normalized to zero. Seller may also sell his single unit outside the relationship at a fixed price. This outside bid is unknown at the time Buyer decides on her investment. It can either be low or high. The probability that the latter case applies is used as a treatment variable. The game now has the following specific setup and sequence of events:

0. *Contracting stage.* Buyer and Seller sign a contract specifying that trade takes place at fixed price $4 \cdot f = 4 \cdot (600)$,[5] and also include a damage schedule $4 \cdot \delta(I)$ in the contract;

1. *Investment stage.* Buyer makes a specific investment $I \in \{0, 5, 10, .., 100\}$. The size of the investment determines Buyer's valuation of the good, which equals $4 \cdot R(I) = 4 \cdot (1000 + 100 \cdot I)$. Investment costs equal $4 \cdot C(I) = 4 \cdot (I^2)$ and are immediately borne by Buyer;

2. *Nature draws outside bid.* The value of Seller's alternative trading opportunity $b \in \{0, 7000\}$ becomes publicly known. The prior probability that $b = 7000$ equals either $p = \frac{1}{5}$ (Low-treatment) or $p = \frac{3}{5}$ (High-treatment);

3. *Breach decision stage.* Seller decides whether to breach the contract or not. This decision determines the *gross surplus up for renegotiation RS* and the *threat points TP_i* (for $i = S, B$) that apply in every round of the bargaining stage, see stage 4 below. If Seller breaches, it holds that:

$$RS = R(I),\ TP_B = \delta(I) \text{ and } TP_S = b - \delta(I),$$

   and if Seller does not breach, we have:

$$RS = b,\ TP_B = R(I) - f \text{ and } TP_S = f;$$

4. *Bargaining stage.* Buyer and Seller first simultaneously decide whether they want to renegotiate or not. Only when both agree to do so, actual renegotiations take place. In that case Buyer and Seller alternate in making offers up to a maximum of *four* bargaining rounds, of how to divide *four* equally sized pies of size RS. Seller makes the first offer. In case of acceptance all remaining pies – including the one of the current round – are divided according to the proposal agreed upon. During a round of disagreement the pie of that round vanishes and both parties receive their threat point payoffs. When parties decide not to renegotiate Buyer and Seller obtain *four* times their threat point payoffs.

[5] Hence $f = 600$. The interpretation of the factor 4 will become clear below when we discuss the players' payoffs. Note that the initial contract is pre-determined and cannot be chosen by the parties themselves. A full analysis for any contract price f can be found in Appendix A.

The overall payoffs Π_B and Π_S of Buyer and Seller depend on the absolute share s Seller receives of the round pie of size RS, and on the bargaining round t during which parties reach agreement (in case of no renegotiations or no agreement $t = 5$):

$$\Pi_B = (5 - t) \cdot (RS - s) + (t - 1) \cdot TP_B - 4 \cdot C(I) \tag{1}$$

$$\Pi_S = (5 - t) \cdot s + (t - 1) \cdot TP_S \tag{2}$$

For ease of exposition we will in the sequel always work with the *average payoffs per bargaining round*. These are given by $\pi_i = \frac{\Pi_i}{4}$ for $i = B, S$. Note that the number of bargaining rounds just works as a scaling factor. For any even number of bargaining rounds the equilibrium predictions concerning investment levels and the division of the surplus are exactly the same (cf. Sloof 2000). By considering the average payoffs per bargaining round all results become directly comparable with those in Sloof et al. (2003) where exactly the same parameterization for $R(I)$, $C(I)$, f and b is used.

Intuitively the order of play can be interpreted as follows. At the start of the game the status quo is trade according to the terms of the initial contract; Seller sells to Buyer at fixed price $f = 600$. After the outside bid becomes known Seller may change this status quo outcome into separation, just by breaching the contract and paying $\delta(I)$ to Buyer. This change may be attractive for Seller, either because separation itself is more profitable, or because it induces a profitable (i.e. upwards) renegotiation of the initial trade price of 600. Hence breach of contract does not necessarily lead to separation, because the parties may renegotiate this decision into trade. The same applies when Seller decides not to breach. This does not necessarily lead to trade, because parties may renegotiate into separation at a lower damage payment. In general, the parties can renegotiate the outcome of Seller's breach decision to arrive at the ex post efficient outcome.

The three sophisticated damage schedules that we study come are characterized by the following damage payments:

- Liquidated damages (LI): $\delta_{LI}(I) = \delta_{LI} = 3400$;
- Expectation damages (EX): $\delta_{EX}(I) = R(I) - f = R(I) - 600$;
- Reliance damages (RE): $\delta_{RE}(I) = C(I) = I^2$.

The main question of interest is whether these damage payments create efficient investment incentives. Our parameter choices are such that (for the efficient investment level) trade is efficient when $b = 0$, while separation is efficient when $b = 7000$. From a social point of view the investment thus only pays off when $b = 0$. It is straightforward to derive that the efficient level equals $I^* = 40$ in the Low-treatment ($p = \frac{1}{5}$) and $I^* = 20$ in the High-treatment ($p = \frac{3}{5}$). Note that the efficient reliance level is *decreasing* in p. Comparative statics in p will play an important role in detecting the two motives to overinvest.

2.2 Equilibrium predictions

The subgame perfect equilibria of the game described in the previous subsection can be obtained through backwards induction. The formal derivation can be found in Appendix A. In this subsection we provide a more intuitive explanation of equilibrium behavior. We do so by comparing the current extended setup with the one in which the renegotiation stage is absent.

First suppose that renegotiation is not possible. The game then ends with Seller's breach decision in stage 3. In that case, when Seller does not breach he obtains the fixed price f. In case of breach he sells his single unit to the outside buyer at price b, but also has to pay the original Buyer $\delta(I)$ in damages. Seller thus chooses to breach iff $f < b - \delta(I)$.[6]

Next consider what happens in the presence of ex post renegotiation. When the breach decision of Seller induces the efficient outcome – i.e. trade when $R(I) \geq b$ and no-trade in case $b > R(I)$ – renegotiations will not take place. This holds because no agreement exists that makes both Buyer and Seller better off. In case Seller's breach decision would lead to an inefficient outcome, such mutually beneficial agreements do exist. Theory predicts that then renegotiations will take place. The predicted outcome of the particular bargaining game employed coincides with the Nash bargaining solution (cf. Sloof 2000). This entails that both parties receive their threat point payoffs and that the remaining surplus is divided equally. This is typically also referred to as the split-the-difference solution.

Obviously, Seller's breach decision changes in the presence of renegotiation. He now also has to take into account that inefficient outcomes are renegotiated into efficient ones, yielding him an additional benefit. In particular, no breach will yield him now $f + \frac{1}{2} \cdot \max\{b - R(I), 0\}$. The second term follows from the fact that when separation is efficient, Seller's decision not to breach will be renegotiated into separation. The joint gains $b - R(I)$ from doing so are then shared equally. Similarly, breach leads to payoffs equal to $b - \delta(I) + \frac{1}{2} \cdot \max\{R(I) - b, 0\}$ for Seller. Here the second term follows from renegotiating an inefficient breach. Comparing the two payoffs, it follows that Seller breaches whenever:

$$f < b - \delta(I) + \frac{1}{2} \cdot (R(I) - b) \tag{3}$$

Compared with the no-renegotiation case the last term on the r.h.s. is added. Breach of contract thus becomes relatively more (less) attractive when b is low (high).

Under what circumstances Seller breaches depends on the damage payment $\delta(I)$ in place. In case of liquidated damages (LI) the breach decision depends on the exact amount δ_{LI}. Three main cases can be distinguished. First, for a

[6]Here we resolve any indifference in favor of selling to (the incumbent) Buyer. This tie-breaking assumption is inessential for our results.

sufficiently low fixed payment, Seller breaches both when b is low and when b is high. Second, for a sufficiently high fixed payment, Seller never breaches.[7] Third, the fixed payment can equal an intermediate value such that Seller breaches only when b is high.[8] Our choice of $\delta_{LI} = 3400$ fits within this intermediate case. Anticipating Seller's breach decision, Buyer then realizes that her investment pays off only when $b = 0$. She therefore chooses the efficient investment level $I_{LI} = I^*$. Recall that the efficient investment level is decreasing in the probability of a high outside bid. Because for the equilibrium investment level Seller's equilibrium breach decision is efficient, renegotiations are predicted not to occur.

Under expectation damages (EX) inequality (3) reduces to $0 < \frac{1}{2} \cdot (b - R(I))$. This implies that the equilibrium breach decision is always efficient. For any level of investment chosen renegotiations are therefore predicted not to occur. With expectation damages Buyer's payoff is independent of Seller's breach decision. She obtains her expectancy $R(I) - 600$ in either case. It follows immediately that she chooses $I_{EX} = 50$ in equilibrium, irrespective of the value of p. Overinvestment under EX is due to the full insurance motive. Buyer is fully protected against separation.

Finally consider the case of reliance damages (RE). Here Buyer is also fully insured against separation. She therefore invests at least 50. But now there is an additional motive to overinvest. To see this, consider Seller's breach decision. Given the relevant range of $I \geq 50$, Seller never breaches when $b = 0$. But in case of $b = 7000$, Seller breaches whenever $I \leq 85$. He does so either to trade with the outside buyer ($50 \leq I < 60$), or to renegotiate better terms of trade with the original Buyer (i.e. when $I \geq 60$ and thus $R(I) \geq 7000$). In the former case Buyer is compensated completely for the investment costs made. She thus obtains a net payoff of zero. In the latter case, besides being reimbursed fully for the costs of investment, Buyer also receives a net profit in the form of an equal share of the surplus up for renegotiation $R(I) - 7000$. In principle this gives her an incentive to invest just up to the amount for which Seller is still willing to breach the contract and pay reliance compensation, i.e. $I = 85$. Here Buyer overinvests to make separation inefficient. However, Buyer also has to realize that she has to bear the costs of investment when it turns out that $b = 0$ and Seller does not breach. This reduces her incentives to invest more than 50.

Which of the above two effects dominates depends on p. When a high outside bid is rather unlikely ($p = \frac{1}{5}$), it does not pay for Buyer to affect the outcome under this contingency. Here only the insurance motive to overinvest is present and Buyer chooses $I_{RE} = 50$. Renegotiations are then predicted not to occur. But when p is relatively high ($p = \frac{3}{5}$) it does pay for Buyer to affect the efficient

[7] The first case formally corresponds with the no-contract situation, the second one with the remedy of specific performance. Both these cases are discussed in Section 5.

[8] Actually breach is also predicted to occur when b is low and a very high investment level I is chosen; for our parameters $I > 70$. Such high investment levels are typically not observed.

outcome when the outside bid is high. In that case Buyer chooses $I_{RE} = 85$,[9] such that Seller surely breaches when $b = 7000$. This triggers renegotiation, to arrive at the ex post efficient outcome. In this second case both the insurance and the separation prevention motive are present. Note that under RE equilibrium investment levels are increasing in p.

Based on the above predictions we formulate our first three hypotheses:

H1 Under LI reliance levels are *decreasing* in p, under EX they are *independent* of p and under RE reliance levels are *increasing* in p.

H2 (i) Reliance levels are higher under EX and RE than under LI; (ii) Reliance levels are higher under RE-High than under EX-High; (iii) Under LI observed investment levels equal the efficient levels.

H3 Renegotiations occur only when it is efficient to do so. They do not occur under LI, EX and RE-Low, but do occur under RE-High (when $b = 7000$).

The first two hypotheses relate to the two motives to overinvest. Hypothesis 1 is based on the *within* remedy comparative statics predictions comparing the Low and the High-treatment. A complementary way to establish whether the two motives to overinvest are present is to look at the *between* remedy comparative statics predictions. This is done in Hypothesis 2. The third hypothesis concerns the renegotiation stage added in this experiment. It predicts that renegotiations occur only when it is in the parties joint interest. When Buyers' investment choices and Sellers' breach decisions correspond with equilibrium behavior, renegotiations are predicted to occur only in the RE-High treatment.

3 Experimental design

We ran two sessions per breach remedy. Within a session subjects were confronted with both the Low and the High-treatment. Per session 20 subjects participated, giving 120 subjects in total. They were recruited from the undergraduate student population of the University of Amsterdam. Most of them were students in economics. Subjects received a show up fee of 30000 experimental points. The conversion rate was one guilder for 2200 points, such that one US dollar corresponded with about 5500 points. Average earnings were USD 19.50 in about two hours.

Each session consisted of 12 periods in which subjects played the four-stage game. These 12 periods were divided into two blocks of six. In one block the value of p was $\frac{1}{5}$ (Low-treatment), in the other block p was equal to $\frac{3}{5}$ (High-treatment). To control for order effects we conducted for each breach remedy

[9] This equilibrium level follows from allowing multiples of 5 only. In the continuous case the equilibrium reliance level equals $87\frac{1}{2}$ (cf. Appendix A).

one Low-High session and one High-Low session. Subjects' roles varied over the rounds. Within each treatment each subject was assigned the role of Buyer three times, and the role of Seller also three times. In each period subjects were anonymously (re)matched. Within a treatment they could meet each other only once. Subjects were explicitly informed about this. Moreover, within each session subjects were divided into two separate groups of 10 subjects. Matching of pairs only took place within these groups. By doing so we generated two independent aggregate observations per session. To enhance comparability the empirical distribution of the outside bid b was exactly the same over the different groups and sessions. We used a distribution that in the aggregate exactly matches the theoretical distribution, but contains sufficient variation over the individual subjects.

The experiment was framed as follows. At the start of each period subjects learned their roles. Then Buyer (subject A) had to choose the amount T, a multiple of five between 0 and 100. (T thus reflects investment choice I.) The costs of this choice equalled $4 \cdot T^2$ and were immediately subtracted from Buyer's account. In the second stage a wheel of fortune determined the value of the outside bid. The wheel had two colors in proportions to the respective probabilities of a low (blue) and a high (yellow) outside bid. When the wheel came to a stop it pointed at a particular color. This color determined the value of the outside bid. In the third stage Seller chose between X (no-breach) and Y (breach). This decision of Seller determined the starting point of the renegotiations. The bargaining stage was organized as described in Subsection 2.1.

The experiment was computerized. Subjects started with on-screen instructions. Before the experiment started subjects had to answer a number of questions correctly. Subjects also received a summary of the instructions on paper (cf. Appendix B). The instructions were phrased neutrally. In particular, words like opponent, game, investment, player, buyer or seller were not used. Before the play of the 12 periods one practice period was played. At the end of the experiment subjects filled out a short questionnaire and the earned experimental points were converted to money. Subjects were paid individually and discreetly.

We made a large effort to present the procedures to the subjects in a very clear and accessible way. The instructions explained carefully how the combination of Buyer's choice of T in stage 1, Nature's draw of b in stage 2 and Seller's breach decision in stage 3 together determined the threat points and the renegotiation surplus for stage 4. After each decision/draw, the consequences were made explicit. In particular, before the buyer's investment choice the subjects had on their screens a table which expresses payoffs as functions of T, b (the color of the wheel) and Seller's breach options (X or Y). After the buyer made her investment choice, the actually chosen value of T replaced the symbol T. Before the wheel of fortune turned, the table contained amounts in yellow and blue. When the wheel stopped at e.g. yellow, the amounts in yellow remained yellow, while those in blue became grey because they were no longer relevant. Similarly, after Seller's choice between X and Y the numbers belonging to the option that was not chosen became grey. In this way, subjects received the information about decisions and draws made in the previous stages and their consequences in a clear-cut and concise way. Appendix C contains examples of the computer screens described here.

4 Results

4.1 Reliance levels

Our first result concerns the relationship between reliance levels and the probability of a high outside bid (cf. Hypothesis H1).

Result 1. *Under LI reliance levels are decreasing in p, while under EX they remain virtually constant. Under RE reliance levels increase when p increases.*

Evidence for Result 1 is provided in Table 1, which reports average investment levels by treatment. (Ignore the columns labeled "optimum" for the moment.) Recall that each subject in the experiment makes 6 investment decisions: 3 decisions in the Low-treatment and 3 decisions in the High-treatment. For each subject we calculated the mean investment levels in these two treatments. We first report the results of statistical tests based on these average investment levels of individual investors.[10] Wilcoxon signrank tests are used to test for differences within a row (last column in upper part) and Mann-Whitney ranksum tests for differences within a column (see the lower part of Table 1). Whenever theory predicts no differences two-sided tests are used, otherwise one-sided tests are employed

Result 1 relates to the within-remedy comparisons. In line with theoretical predictions investment levels are decreasing in p under liquidated damages. Under EX we observe a 5% decrease in case p increases. While statistically significant, economically the size of this effect can be viewed as insignificant. We therefore

[10]These tests are based on pooled sessions. Using Mann-Whitney ranksum tests, in 5 out of 6 treatments we found no differences at the 5 percent level in investment rates between the two sessions that were held for each of the treatments. (These tests are based on the mean reliance levels per p-level of each subject.) The single exception concerns the EX-High treatment. Here reliance levels in one session were significantly higher than in the other session ($51.75 > 46.75$, $p = 0.003$). This points at an order effect; the higher investment levels are observed for the Low-High order. Yet for the other five treatments order effects are absent.

Pooling over the sessions does not affect our conclusions. When we consider the two EX sessions in isolation, we observe that in one of them reliance levels are significantly decreasing in the probability of a high outside bid ($p = 0.02$), but in the other session this is not the case. There reliance levels under the EX-Low and EX-high treatment are not significantly different from each other ($p = 0.48$). This supports the conclusion drawn in Result 1.

conclude that under EX investment levels remain virtually constant. Under RE investment levels are increasing in p, as predicted.

A second set of statistical tests, based on the group level data, confirms these conclusions. We divided the 20 subjects within a session into two groups that were independently matched. Members of one group were never matched with members of the other group. We thus have for each remedy four independent observations at the aggregate group level. Under LI all groups invest more in the Low-treatment than in the High-treatment. For the RE breach remedy we observe the exact opposite. Reliance levels are higher in the High treatment. Under EX we find that three groups invest less in the High-treatment, while one group invests more. With four matched pairs of observations per remedy, the smallest possible significance level that a one-tailed signrank test can attain equals 6.25 percent. For LI and RE we then obtain significant differences at this level of 6.25 percent between the Low and the High treatments. Clearly, on the aggregate group level no significant differences exist between EX-Low and EX-High.

The next result relates to the absolute reliance levels and to a comparison across the different damage payments (cf. Hypothesis H2).

Result 2. *(i) In both the Low and the High-treatment reliance levels are significantly higher under EX and RE than under LI. (ii) Reliance levels are also significantly higher under RE-High than under EX-High. (iii) Under all three remedies overinvestment occurs.*

Evidence for the first two parts of Result 2 is provided in the lower part of Table 1. Ranksum tests reveal that the between-remedy differences in reliance levels are in most cases significant. The single exception concerns EX-Low versus RE-Low. Here no differences are found at the aggregate group level. The significant differences found are in line with the predictions. Specifically, under LI reliance levels are lower than under EX and RE, and reliance levels are higher in the RE-High treatment than in EX-High.

The third part of Result 2 follows from a comparison of the average reliance levels with the predicted levels. Taking all investment decisions into account, it turns out that in two of the six treatments average reliance levels deviate substantially from the theoretical predictions. For LI-High the actual investment level exceeds the predicted level by more than 50%. For RE-High the average investment level is substantially below the predicted level. In the other four treatments the mean reliance levels are fairly close to the predicted levels. When we consider final investment decisions only, we observe that these are not significantly different from the means of all investment decisions in four of the six treatments (Wilcoxon signrank tests on individual mean investment rates, 5% level). The two exceptions are exactly LI-High and RE-High. Here significant learning effects are found. In both treatments the adjustment is in the direction of the predicted

Table 1: Mean investment levels by treatment and tests for equality

	Low: $p = \frac{1}{5}$ efficient: 40			High: $p = \frac{3}{5}$ efficient: 20			Signrank tests ($p-$values) Low vs. High
damages	predicted	actual	"optimum"	predicted	actual	"optimum"	
LI	40	46.71	33.40	20	32.21	19.10	0.0001
		(12.96)	(3.16)		(15.80)	(5.97)	0.0625
EX	50	52.54	50.00	50	49.25	48.47	0.0324^d
		(7.84)	(0.04)		(5.56)	(0.79)	0.3750^d
RE	50	58.08	56.24	85	68.88	.	0.0002
		(12.38)	(4.46)		(13.23)	.	0.0625

	Ranksum tests ($p-$values)	Ranksum tests ($p-$values)
LI vs. EX	0.0072	0.0000
	0.0571	0.0143
LI vs. RE	0.0001	0.0000
	0.0143	0.0143
EX vs. RE	0.0243^d	0.0000
	0.1572^d	0.0143

Remark: For each comparison the upper p-values are based on mean investment levels of individuals, the lower values on mean investment levels per group. Tests are one-sided, except those with superscript d which are double-sided. Standard deviations appear in parentheses.

investment levels. For LI-High the mean investment level decreases (to 25.75 on average) and for RE-High it increases (to 74.63 on average). Hence, experienced subjects choose investment levels which are fairly close to the predicted levels.

Results 1 and 2 provide strong evidence that both motives for overinvestment are at work. First, the operation of the full insurance motive is supported by the difference between the comparative statics results for EX and LI reported in Result 1, and by the across remedies comparison between EX (and RE) and LI reported in Result 2. Second, both the difference between the comparative statics results for RE and EX (Result 1) and the significant difference between observed investment levels under RE-High and EX-High (Result 2) point at the presence of the separation prevention motive. In the no-renegotiation setup of Sloof et al. (2003) the same comparative statics results were obtained. The two experiments together thus provide ample evidence for the relevance of the two overinvestment motives distinguished in the theoretical literature.

4.2 Renegotiations

Hypothesis H3 predicts that renegotiations occur only when it is efficient to do so. This implies that, given equilibrium investment and breach behavior, they do not occur under LI, EX and RE-Low, but do occur under RE-High. Our next result relates to this.

Result 3. *Effective renegotiations almost never (<1%) occur when it is inefficient to do so. In case it is efficient to renegotiate, effective renegotiations take place in about 83% of the cases. Under EX effective renegotiations are almost absent, while under LI and RE they occur quite often.*

Table 2 presents for each treatment the overall outcome of the renegotiation stage. The left hand part of the table considers situations in which renegotiations are predicted to take place. Here the breach decision of Seller would by itself result in an inefficient outcome. The right hand part concerns cases where Seller's breach decision is efficient. Then renegotiations are not needed to arrive at the efficient outcome. (When $b = R(I)$ both trade and separation are efficient.) The columns labeled 'agree' report the number of observations in which the parties arrived at an agreement during the renegotiations. Under 'disagree' we report the number of renegotiations that ended in disagreement. The columns labeled 'no-ren.' list the number of instances in which at least one of the subjects within a pair did not want to renegotiate.

Apart from simply refusing to do so, in the experiment there is a second way to reveal an unwillingness to renegotiate *efficient* outcomes. Subjects could always demand at least their threat point. When Seller's breach decision is efficient, such that the surplus up for renegotiation falls short of the sum of the two threat points, such a strategy would lead to disagreement. For this

Table 2: Occurrence of renegotiations

	inefficient outcome			$b = R(I)$	efficient outcome		
	renegotiation		no-ren.		renegotiation		no-ren.*
	agree*	disagree			agree	disagree*	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
LI-Low	16 (10)	5 (3)	5 (4)	1 (0)	0 (0)	7 (0)	86 (1)
LI-High	20 (12)	0 (0)	5 (4)	2 (0)	0 (0)	4 (0)	89 (2)
EX-Low	1 (1)	0 (0)	6 (6)	0 (0)	0 (0)	6 (0)	107 (0)
EX-High	7 (7)	1 (1)	5 (5)	6 (0)	2 (0)	7 (0)	92 (0)
RE-Low	43 (31)	1 (0)	0 (0)	1 (0)	1 (0)	4 (0)	70 (5)
RE-High	36 (7)	6 (2)	7 (2)	6 (0)	1 (0)	1 (0)	63 (5)

Remark: The left (right) hand part of the table concerns cases where Seller's breach decision results in an inefficient (efficient) outcome. Equilibrium predictions are marked with an *. Per row the total number of observations equals 120. Within parentheses appear the number of non-equilibrium breach decisions.

reason we interpret renegotiations of efficient outcomes that end in disagreement as indicative of an unwillingness to renegotiate (column (6) in Table 2). The remaining renegotiations that take place are referred to as *effective* renegotiations. These are the numbers reported in the columns (1), (2) and (5). We then observe that effective renegotiations of efficient outcomes (column (5)) take place in only 4 out of 540 cases. The picture is markedly different when it is efficient to renegotiate. Then effective renegotiations take place in overall 136 out of 164 cases (83%). These cases mainly belong to the LI and RE remedies. Yet there seems to be no systematic pattern over the Low and High treatments.

Overall we conclude that the occurrence of renegotiations *conditional* on the actual investment and breach decisions is well in line with theoretical predictions. Renegotiations typically only take place when there are efficiency gains to be made ex post. At the same time we observe that under LI and RE-Low renegotiations of inefficient outcomes occur considerably more often than predicted. The explanation for this lies in investment and/or breach decisions that deviate from the equilibrium predictions.

Under expectation damages renegotiations of inefficient outcomes are rather infrequent. But when they occur, they can be attributed completely to disequilibrium breach behavior. This holds because under expectation damages the breach decision is predicted to be efficient, irrespective of the reliance level chosen. An inefficient outcome after the breach decision stage is thus necessarily a consequence of a non-equilibrium breach decision. Under LI and RE-Low the situation is more complicated. There inefficient outcomes can be caused by either non-equilibrium investment levels or non-equilibrium breach decisions.[11] The numbers within parentheses in Table 2 report the latter. Overall for LI and RE-Low we observe that around 66% (56 out of 85) of the renegotiations are caused by non-equilibrium breach decisions. Apparently Sellers expect to get out more from the renegotiations than predicted.

Only under RE-High renegotiations of inefficient outcomes are actually predicted to occur. In particular, given $I^*_{RE} = 85$ they should occur when $b = 7000$. Theoretically we thus should expect $\frac{3}{5} \cdot 120 = 72$ renegotiations of inefficient outcomes. The observed number of 42 is much lower. Moreover, 9 of these can be attributed to non-equilibrium breach decisions. Only the remaining 33 observations can be attributed to Buyer trying to prevent separation through overinvestment. Hence, compared to the theoretical prediction Buyer invests too little. A possible explanation for this could be that Buyer's gains from the renegotiations are also smaller than predicted. We turn to this issue now.

Result 4. *First offers and final agreements under LI, EX and RE give Buyer on average a share between the equal split and the theoretically predicted 'split-the-difference' solution. Under LI and RE Buyer also gets a smaller marginal return on investment than predicted.*

Table 3 reports the outcome of the renegotiations observed after an inefficient breach decision. There are two rows per treatment: the first row concerns Sellers' first offers, the second row agreements. Column (1) reports the average equilibrium prediction for Buyer's share (given actual investment), the next column her average actual share and column (3) the average equal split outcome. Also the average number of bargaining rounds it takes to reach agreement is reported, together with the number of observations on which the averages are based. In all treatments final agreements lie in between the equal split and the equilibrium 'split-the-difference' solution. Buyers thus on average indeed earn less in the renegotiations than predicted.

For investment incentives the marginal return on investment is important. Under LI only 6 of the 41 renegotiations reported in Table 3 take place after an inefficient decision not to breach. In these cases Seller decided not to breach, although separation is efficient (i.e. $b = 7000$ and $I < 60$). The remaining 35 observations all concern inefficient breaches. There Seller decided to breach, while trade between the original parties is efficient (either because $b = 0$, or $b = 7000$ and $I \geq 60$). This also applies for all 86 renegotiations observed under RE. We

[11] Clearly, inefficient outcomes may result after both a dis-equilibrium reliance level and a non-equilibrium breach decision. In that case, like under expectation damages, we attribute the inefficient outcome to the non-equilibrium breach decision.

Table 3: Outcome of renegotiations of inefficient outcomes

		Buyer's average share			# of	n
		predicted	actual	equal split	rounds	
		(1)	(2)	(3)	(4)	(5)
LI-Low	First	6460	4274	3560	·	21
	Accepted	6447	5519	3484	2.31	16
LI-High	First	5050	2825	3338	·	20
	Accepted	5050	4588	3338	2.25	20
EX-Low	First	8400	5000	3000	·	1
	Accepted	8400	5500	3000	2	1
EX-High	First	6213	3775	3438	·	8
	Accepted	6257	5843	3429	1.86	7
RE-Low	First	6579	4964	3358	·	44
	Accepted	6637	5567	3378	2	43
RE-High	First	7197	6282	4185	·	42
	Accepted	6915	6716	4097	1.69	36

Remark: # of rounds gives the average number of bargaining rounds. n denotes the number of observations.

Table 4: Regressions explaining first/accepted offers after inefficient breach

	liquidated damages			reliance damages		
	pred.	first offer	accepted	pred.	first offer	accepted
const.	3900	−760	3915	500	−224	556
		(1689)	(893)***		(903)	(729)
b	−.5	−.314	−.452	−.5	−.091	−.250
		(.106)***	(.055)***		(.051)*	(.042)***
I	50	78.0	−39.9	50	65.6	34.3
		(56.8)	(30.65)		(32.3)**	(26.3)
I^2	0	.034	.987	1	.284	.815
		(.464)	(.253)***		(.300)	(.248)***
t	0	91.2	105	0	77.0	59.4
		(88.3)	(44.5)**		(40.3)*	(33.2)*
n	45	35	30	93	86	79
adj. R^2		.46	.81		.67	.81

Remark: Regressions explaining Buyer's share. Standard deviations within parentheses. Significant coefficients at 1%/5%/10% level are marked with ***/**/*.

therefore concentrate on renegotiations that follow after an inefficient breach. For these cases Table 4 present results from regressing first offers and final agreements on the value of the outside bid, the investment level the squared investment level (i.e. investment costs) and a period trend. The latter is included to correct the estimates for possible experience effects.

Under LI (left hand part) we observe that Sellers' first offers are not significantly affected by the investment made. Final agreements appear to proportionally increase with the costs of investment I^2, but do not give Buyer a positive net return on investment. Hence, when it comes to renegotiations, Buyer gets a smaller net return on investment than predicted. Similar conclusions are obtained under reliance damages (right hand part of Table 4). For agreements the marginal return on investment is always lower than predicted.[12] A potential explanation here is that Seller may not be willing to give in because of negative reciprocity considerations. Since a higher investment makes Seller worse off in expected payoffs, he may want to punish Buyer for excessive overinvestment.

Result 4 suggests that Buyer does not always choose the privately "optimum"

[12]For the relevant range of $I \geq 50$ the conclusion also applies for first offers.

investment level given actual breach decisions and bargaining outcomes. Under LI Seller is more likely to inefficiently breach than predicted and also manages to get a larger share in the bargaining than predicted. Buyer's actual return on investment is therefore smaller than predicted. Under RE-Low Seller is also more likely to inefficiently breach than predicted. In this case it does not directly affect investment incentives, because under this damage measure Seller has to pay back Buyer's investment costs. Buyer is thus fully insured against separation, and thus still can safely invest $I = 50$. In case of RE-High, in equilibrium renegotiations take place after $b = 7000$ with a marginal net return on investment of 50. Actual renegotiations, however, give Buyer less than this. Investment returns are thus smaller than predicted.

We estimated regression equations with Buyer's *net* payoff as dependent variable, and the level of investment and investment squared as independent variables. To take account of potential experience effects we also included a time trend. The "optimum" levels of investment can be calculated from the estimated coefficients and are reported in Table 1. In RE-High the variance in actual bargaining outcomes was so large that no sensible estimate of the "optimum" investment level could be obtained.[13] The calculated optimum investment levels are close to the actual investment levels for RE-Low, EX-Low and EX-High. For the LI-treatments actual levels exceed the optimum levels.

A potential explanation for the observed overinvestment under LI is that Buyers incorrectly anticipated the outcome of the (breach and) bargaining stage. To see this, note that average first offers are substantially below finally agreed shares (cf. Table 3). Also the marginal return on investment is higher for final agreements than for first offers (Table 4). This suggests a conflict between Buyer and Seller concerning Buyer's share and her return on investment. On the one hand, Buyer may self-servingly expect a larger than 50% return on the investment as compensation for the sunk investment costs borne. On the other hand, Seller may self-servingly believe that he deserves at least half of the return on investment, either because he was unlucky with the draw of a low alternative trading opportunity (i.e. $b = 0$) or because he makes the first offer in the bargaining stage.[14] Previous experiments have shown that such self-serving biases may result in bargaining impasse (cf. Babcock and Loewenstein 1997) and may indeed explain overinvestment (cf. Sloof et al. 2000).

[13]In the regression of net payoffs both I and I^2 were insignificant and the adjusted R^2 equalled .01. In all other treatments both I and I^2 were highly significant. In all treatments the experience parameter was insignificant.

[14]Sellers in the experiment may erroneously think that they have a first mover advantage and therefore should obtain a relatively larger share. The 'split-the-difference' solution also applies when Buyer formulates the first offer.

5 Reliance without sophisticated remedies

5.1 Basic setup, predictions and design

Basic setup The results reported in the previous section reveal that sophisticated breach remedies cause overreliance, as is theoretically predicted. We next turn to the question whether they are actually needed for protection against holdup. In order to answer this we investigate situations where sophisticated breach remedies are absent. We consider two extreme (degenerate) forms of breach remedies. The first one is specific performance (SP). Under this remedy Seller is obliged to sell his unit to Buyer if she requires him to do so. This amounts to a situation in which the breach payment is infinitely high; $\delta_{SP}(I) = \infty$. The second one is the situation without an initial contract (NC). Then there is simply no contract that can be breached and Seller is free to go. This corresponds to the situation of $\delta_{NC}(I) = 0$ and $f = 0$ in the setup of Subsection 2.1.

Naturally, in both cases breach decision stage 3 is obsolete. Under NC there is no initial contract that can be breached. After the outside bid becomes known Buyer and Seller simply negotiate about the terms of (possible) trade. In these negotiations the threat point of Seller equals his outside bid, while the threat point of Buyer equals zero.[15] In case of SP there exists a contract which parties agreed upon in stage 0, but unilateral breach of this contract is forbidden. Parties have the opportunity to renegotiate this contract in stage 4. They may jointly decide to separate at a different damage payment.[16]

Equilibrium predictions Actual (re)negotiations take place only when mutual gains from doing so can be obtained. In the absence of a contract this implies that trade between Buyer and Seller must be efficient ($R(I) \geq b$). In that case Buyer is predicted to get a share equal to $\frac{1}{2}(R(I) - b)$, while Seller obtains the remainder. Note that in the negotiations Seller can "hold up" Buyer, such that she captures only 50% of the marginal return on investment. Anticipating this, Buyer chooses an investment level that is only 50% of the efficient level: $I_{NC} = \frac{1}{2}I^*$. In the absence of a contract underinvestment is thus predicted to occur.[17] Given the equilibrium investment levels negotiations take place only when $b = 0$.

Under specific performance Buyer can always claim trade at a price of $f = 600$. Renegotiations therefore will only take place when trade between the original trading partners appears to be inefficient ($R(I) < b$). In that case Buyer obtains

[15]In the notation of Subsection 2.1: $RS = R(I)$, $TP_B = 0$ and $TP_S = b$.

[16]Here we have $RS = b$, $TP_B = R(I) - f$ and $TP_S = f = 600$.

[17]As shown by Segal and Whinston (2000) holdup in this case cannot be solved by an exclusivity provision. Under such a provision Seller is restricted to sell his unit to Buyer only (but is not required to do so). In our setup Buyer then obtains $\frac{1}{2} \cdot \max\{R(I), b\} = \frac{1}{2} \cdot \max\{R(I) - b, 0\} + \frac{1}{2}b$ in the renegotiations. This is simply $\frac{1}{2}b$ on top of what she receives in the no contract case, and therefore investment incentives are not affected. Of course, this irrelevance result depends on b being independent of I, i.e. the investment being completely specific.

$(R(I) - f) + \frac{1}{2}(b - R(I))$, where the second term equals the gain from renegotiations. Note that when the investment appears socially unprofitable (i.e. when $b = 7000 > R(I)$), Buyer still receives half of the (private) return on investment. In that sense Buyer is partially – for 50% – insured against separation. Under full insurance the equilibrium investment level is 50, while in the absence of insurance it equals the efficient level I^*. Under 50%-insurance the equilibrium investment level then just equals the average: $I_{SP} = \frac{1}{2}(50 + I^*)$. This yields predicted investment levels of 45 in the Low-treatment and 35 in the High-treatment. Hence, also the SP breach remedy is predicted to cause overreliance. The driving force is the partial insurance of Buyer against separation.

The above predictions are summarized in the following two hypotheses:

H4 (i) Under NC there will be holdup. (ii) Under SP overinvestment will be observed. (iii) In both cases reliance levels are decreasing in p.

H5 Renegotiations occur only when it is efficient to do so. Under NC they occur only when $b = 0$, in case of SP they occur only for $b = 7000$.

Experimental design We ran two sessions for the NC-game and two sessions for the SP-game. As before, in each session subjects were confronted with both the low and the high level of p. Per session 20 subjects participated, so that 80 new subjects participated in four sessions. Parameter choices were exactly the same as before. Subjects earned on average USD 21 in two hours.

The additional sessions resembled the previous ones for the sophisticated breach remedies as closely as possible. The only difference was that the game played in each period was now framed as a three-stage game. Breach decision stage 3 was dropped and the renegotiation stage was labeled as being the third stage. Thus, after the wheel of fortune came to a stop subjects immediately turned to the renegotiation stage. In the computer screens (cf. Appendix C) there were only two instead of four columns in the upper table.

5.2 Results

5.2.1 Reliance levels

The main finding concerning investment levels is summarized in Result 5 (cf. Hypothesis H4).

Result 5. *(i) In the High-treatment no holdup is observed under NC, while in the Low-treatment NC leads to underinvestment. (ii) SP always leads to overinvestment. (iii) Under NC investment levels are decreasing in p, while under SP they remain virtually constant when p changes.*

Evidence for Result 5 is provided in Table 5. As before statistical tests are based on both individual mean investment levels and on group level data. There appears to be no holdup problem when the probability of a high outside bid is high. In the absence of a contract Buyer chooses the first best investment level on average. In the Low-treatment holdup does occur, but is less severe than predicted. The latter result is a rather robust finding in the experimental economics literature.[18] An explanation for this result – that received considerable support in these earlier papers – is positive reciprocity. Investment by Buyer makes both agents potentially better off and thus can be considered as a kind act. Seller might want to reward this kind behavior with a larger than predicted return. If such reciprocal behavior is anticipated, it is optimal for Buyer to invest more than predicted. (We come back to this issue in the next subsection.) Under specific performance Buyer invests significantly more than under NC. Substantial overinvestment occurs mainly in the High-treatment, as predicted.

Comparing the actual reliance levels for Low and High, Table 5 shows that investment levels are decreasing in p under NC. In case of SP the group level data reveal no significant differences at the 5% level between the Low and the High-treatment. This clearly indicates the presence of the insurance motive. In contrast to theoretical predictions, however, insurance appears to be complete rather than only partial.[19]

5.2.2 Renegotiations

The first result in this subsection concerns the occurrence of effective renegotiations (cf. Hypothesis H5). As before, *effective* renegotiations refer to the cases where parties display a clear willingness to renegotiate.

Result 6. *Under NC effective renegotiations occur in around 12% of the cases when it is inefficient to do so. Under SP this is almost never the case (<1%). When it is efficient to renegotiate, effective renegotiations take place in 89% of the cases. Under NC effective renegotiations occur mostly after* $b = 0$*, but also occur when* $b = 7000$*. Under SP they only occur after b=7000.*

Table 6 presents the overall outcome of the renegotiation stage. It has the same setup as Table 2. Under NC the status quo outcome is no-trade, while under SP it equals trade. The left (right) hand part of the table considers situations in which the status quo outcome turns out to be inefficient (efficient), given the actual outside bid and the investment level chosen. Theory predicts that effective renegotiations take place only when the status quo is inefficient. Table 6 reveals that effective renegotiations of inefficient outcomes (columns (1) and (2)) take

[18]See e.g. Ellingsen and Johannesson (2000), Hackett (1994), Königstein (2001), Sloof et al. (2000) and Sonnemans et al. (2001).

[19]The test based on individual means yields a statistically significant difference between the Low and the High treatment. Yet economically the difference is very small; only a 7% decrease is observed, while a decrease of 22% is predicted. This explains why we use the term 'virtually' in Result 5(iii).

Table 5: Mean investment levels by treatment and tests for equality

	Low: $p = \frac{1}{5}$ efficient: 40			High: $p = \frac{3}{5}$ efficient: 20			Signrank tests ($p-$values) Low vs. High
damages	predicted	actual	"optimum"	predicted	actual	"optimum"	
NC	20	28.83	12.00	10	21.88	3.44	0.0005
		(12.34)	(7.80)		(13.07)	(7.30)	0.0625
SP	45	49.88	47.54	35	46.63	35.93	0.0273
		(3.89)	(2.39)		(9.87)	(2.90)	0.1250

Remark: For each comparison the upper p-values are based on mean investment levels of individuals, the lower values on mean investment levels per group. All tests are one-sided. Standard deviations appear in parentheses.

Table 6: Occurrence of renegotiations

	inefficient outcome			$b = R(I)$	efficient outcome		
	renegotiation		no-ren.		renegotiation		no-ren.*
	agree*	disagree			agree	disagree*	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
NC-Low	85	8	3	2	3	0	19
NC-High	41 (1)	1	7	2	8	1	60
SP-Low	16	1	6	0	1	19	77 (1)
SP-High	55	5	10	1	0	7	42 (1)

Remark: The left (right) hand part of the table concerns cases where the outcome before stage 4 is inefficient (efficient). Equilibrium predictions are marked with an *. Per row the total number of observations equals 120. Within parentheses appear the number of observations with $b = 7000$ and $I > 60$.

place in overall 212 out of 238 cases (89%). Effective renegotiations of efficient outcomes (column (5)) are essentially absent under SP, but in the absence of a contract occur in 11 out of 91 cases (12%). Here Sellers apparently are satisfied with a more equal distribution of a smaller pie.

In the absence of a contract the status quo outcome equals no-trade. This outcome is necessarily inefficient when $b = 0$, because $R(I) > 0$. The other possibility where no-trade is inefficient corresponds to $b = 7000$ together with $I > 60$. Theory predicts that $I_{NC} < 60$, and thus that the latter situation does not occur. Table 6 reveals that this is indeed the case; instances with $b = 7000$ and $I > 60$ are almost absent under NC (see the number in parentheses). Hence, effective renegotiations of inefficient outcomes (almost) only follow after $b = 0$.

In case of specific performance the status quo outcome equals trade. This status quo is inefficient only when $b = 7000$ together with $I < 60$.[20] Theory predicts that $I_{SP} < 60$, and thus that an inefficient outcome arises whenever $b = 7000$. From Table 6 we observe that this indeed applies; only in two instances we have $I > 60$ together with $b = 7000$ (see the numbers in parentheses under SP). Here the status quo outcome is already efficient, and no renegotiations are needed anymore. These two observations are exceptions though. In line with theoretical predictions, when $b = 7000$ the status quo outcome is (almost) always inefficient, and effective renegotiations are likely to take place.

Overall we conclude that the occurrence of renegotiations *conditional* on the actual investment decision is well in line with theoretical predictions. Renegoti-

[20]Note that the status quo can never be inefficient for $b = 0$. This holds because $b = 0 < 1000 + 100 \cdot I = R(I)$.

ations mainly take place when there are efficiency gains to be made ex post. Yet under NC they sometimes (in around 12% of the cases) occur when it is inefficient to do so. Non-equilibrium reliance levels do not appear to affect the actual occurrence of renegotiations (cf. the numbers within parentheses in Table 6).

For investment incentives the actual renegotiation outcomes are important. We focus on the renegotiations that occur when the status quo appears to be inefficient (columns (1) and (2) in Table 6).[21]

Result 7. *First and accepted offers under NC give Buyer on average a share below the predicted 'split-the-difference' solution. In case of SP accepted offers on average give Buyer her predicted share. In the absence of a contract Buyer also gets a smaller marginal return on investment than predicted.*

Table 7 reports the outcome of renegotiations when the status quo appears to be inefficient. This table has the same setup as Table 3. Under both NC and SP first offers give Buyer on average a smaller share than the predicted 'split-the-difference' solution. Final agreements do give the buyer a larger share than first offers do. But in the process of getting a larger share some of the surplus is lost. Across Low and High, it takes on average 1.6 rounds to reach agreement under NC and almost 2 rounds under SP. , while under SP this is 1.96. On average Buyer is therefore better off by accepting Seller's initial offer.

We next consider the marginal return on investment. We regressed first offers and accepted offers on the investment level, the squared investment level and a time trend. Results are reported in Table 8. Theoretically the sunk investment costs I^2 do not affect bargaining outcomes. However, under NC we do find that sunk costs matter. The coefficient on I^2 is significant. When we consider Sellers' first offers, the coefficient on I appears insignificant. Because the coefficient for I^2 is less than one, the marginal return on investment always fall short of the marginal costs. For accepted offers the coefficient on I is significant. The marginal return on investment then equals on average 49%.[22] This corresponds well with the predicted 50% marginal return. However, this return is obtained only after some delay (cf. Table 7). The overall return on investment is thus less than predicted.[23]

Under specific performance Sellers' first offers are unaffected by the investment level chosen. For accepted offers the marginal return at the average investment

[21]Under NC only 1 out of the 135 renegotiations of inefficient outcomes takes place after $b = 7000$ (see the number in parentheses in Table 6). We excluded this observation and focus on those for $b = 0$. Under SP all renegotiations of inefficient outcomes belong to $b = 7000$.

[22]With an average investment level of 25.56 this follows from: $15.7 + 2 \cdot 0.646 \cdot (25.56) = 48.72$.

[23]When $b = 7000$ we also do not get a significant coefficient for I and I^2. Moreover, the number of cases in which renegotiations then occur are rather small: 12 out of 96 cases. In the contingency where the outside bid is high the buyer thus gets no return on the investment, as is predicted.

Table 7: Outcome of renegotiations of inefficient outcomes

		Buyer's average share			# of rounds	n
		predicted	actual	equal split		
		(1)	(2)	(3)	(4)	(5)
NC-Low	First	1909	1445	1909	·	93
	Accepted	1888	1755	1888	1.61	85
NC-High	First	1543	1283	1543	·	41
	Accepted	1544	1498	1544	1.58	40
SP-Low	First	5856	5347	3500	·	17
	Accepted	5853	5950	3500	1.88	16
SP-High	First	5621	4950	3500	·	60
	Accepted	5618	5675	3500	1.98	55

Remark: # of rounds gives the average number of bargaining rounds. n denotes the number of observations.

Table 8: Regressions explaining first/accepted offers

	No contract, $b = 0$			Specific performance, $b = 7000$		
	pred.	first offer	accepted	pred.	first offer	accepted
const.	500	549	768	3400	2424	2415
		(194)***	(136)***		(880)***	(382)***
I	50	13.9	15.7	50	68.6	172
		(10.8)	(7.65)**		(64.4)	(29.2)***
I^2	0	.575	.646	0	$-.229$	-2.02
		(.152)***	(.107)***		(1.04)	(.476)***
t	0	-4.65	-9.34	0	$-.341$	-4.31
		(15.3)	(10.7)		(38.08)	(16.9)
n	144	134	125	96	77	71
adj. R^2		.65	.82		.19	.59

Remark: Regressions explaining Buyer's share. Standard deviations within parentheses. Significant coefficients at 1%/5%/10% level are marked with ***/**/*.

level equals $-11\frac{1}{2}\%$.[24] This suggests that the marginal return on investment is smaller than the predicted value of 50%. It must be noted though that, in contrast to the no-contract situation, here renegotiations are not needed to obtain a return on investment. As long as no agreement has been reached, or when no renegotiations take place at all, Buyer gets a 100% marginal return through her threat point. A lower return on investment in the actual renegotiations may induce a lower willingness to enter these renegotiations, thereby *increasing* investment incentives. Indeed, in 13 out of the 16 cases in which parties did not renegotiate an inefficient outcome, it was Buyer who did not want to bargain. Therefore, for SP no definite conclusions concerning the actual return on investment remain ambiguous.

Result 7 suggests that, especially in the absence of a contract, buyers do not choose the "optimum" investment level given actual bargaining outcomes. We estimated the "optimum" investment levels in the same way as we did for the sophisticated breach remedies. These are reported in Table 5.

Without a contract the "optimum" investment levels do not differ significantly from zero. The variance in actual bargaining outcomes is then particularly large, resulting in large standard deviations. Relative to these calculated optima Buyer overinvests in the NC-treatments. Positive reciprocity (as discussed in Subsection 5.2.1) seems to play no role, because the "kind" act of higher investments yields Buyer no return at all. A common sense explanation for the observed overinvestment under NC is given by the self-serving bias discussed at the end of Section 4. Under specific performance the "optimum" investment levels are near the theoretical predictions. Also here Buyer overinvests, especially in the SP-High treatment. An explanation for the latter result is that buyers overlook that when their own threat point increases, the net surplus up for renegotiation decreases (when $b = 7000$). They thus take the gross marginal return to be 100% in every contingency, making an investment of 50 optimal. Indeed, even in the High-treatment the distribution of reliance levels is very concentrated around the mode of 50 (the frequency belonging to this mode exceeds 80%).

6 Efficiency comparison

The ultimate aim of breach remedies is to increase efficiency. In this section we compare all five different cases of Sections 4 and 5 in terms of efficiency. Theory predicts that efficiency losses are solely due to inefficient investments. The breach and renegotiation stage cause no waste of the available surplus. The predicted efficiency ranking thus follows directly from investment incentives. In particular, we have that:

H6 In both the Low and the High-treatment efficiency is highest under LI.

[24] With an average investment level of 45.42 this follows from: $172 - 2 \cdot 2.02 \cdot (45.42) = -11.50$.

Our final result reveals that realized efficiency deviates from this prediction.

Result 8. *(i) In the Low-treatment efficiency is highest under SP. Both investment and bargaining inefficiencies are smallest in this case. (ii) In the High-treatment efficiency is highest under NC. This is solely due to the small investment inefficiency under NC.*

The result is supported by the findings on joint payoffs reported in Table 9. As before the amounts are normalized per bargaining round. Column (1) gives the expected joint payoffs when subjects make equilibrium choices. The second column contains the average realized joint payoffs. By subtracting these amounts from the maximum surplus $S(I^*)$ the overall observed inefficiencies are obtained. Columns (3) to (5) disentangle these into three different sources: investment inefficiency, bargaining inefficiency and residual inefficiency. Investment inefficiency equals the loss in expected surplus due to suboptimal investment. In calculating the investment inefficiency it is assumed that the bargaining stage is efficient. The bargaining inefficiency in column (4) is the sum of losses owing to parties deciding not to renegotiate when they should and losses due to delay of agreement.[25] The third source of inefficiency is due to the fact that the empirical distribution of b conditional on the investment level chosen may differ from the theoretical distribution.[26] The resulting (in)efficiency cannot be attributed to subjects' decisions and is therefore referred to as residual inefficiency. The last two columns express predicted and actual joint payoffs as fractions of maximum expected joint payoffs $S(I^*)$.

Contrary to Hypothesis H6, liquidated damages are less efficient than predicted and outperformed either by SP (Low-treatment) or NC (High-treatment).[27] In the Low-treatment SP appears to be most efficient, both in terms of investment efficiency and in terms of bargaining efficiency. The reason that specific performance generates small bargaining losses in this treatment is that very few pairs actually enter the bargaining stage, as is predicted. For the same reason relatively small amounts are wasted in the bargaining stage under expectation damages. In the High-treatment none of the breach remedies performs better than NC in terms of overall efficiency. Here the driving force is investment inefficiency. In the absence of a contract holdup is much less severe than predicted, keeping investment inefficiencies lower than predicted. Bargaining inefficiencies are substantial, as under all breach remedies considered.

[25]Notice that the breach decision itself can never be a source of inefficiency because an inefficient breach decision can always be renegotiated.

[26]Our design ensured that the realized frequencies of high outside bids exactly equalled 20 percent and 60 percent in the Low and High treatments respectively. That is, we controlled the unconditional empirical distribution of b. We did not control the distribution of b conditional on the investment made.

[27]Although note that the difference between LI-High and NC-High is not significant at the 10%-level.

Table 9: Joint payoffs and efficiency

		predicted expected (1)	average realized (2)	inv. ineff. (3)	barg. ineff. (4)	res. ineff. (5)	(1) / $S(I^*)$	(2) / $S(I^*)$
	NC	3400	2586_{abcd}	332	842	40	0.89	0.68
	SP	3775	3575_{aef}	121	100	4	0.99	0.94
Low	LI	3800	2792_{beg}	244	729	35	1	0.73
	EX	3700	3292_{cgh}	270	221	17	0.97	0.87
	RE	3700	2725_{dfh}	535	564	-24	0.97	0.72
	NC	4900	4169_{i}	248	535	48	0.98	0.83
	SP	4775	3894_{j}	823	331	-48	0.96	0.78
High	LI	5000	4040_{k}	518	367	75	1	0.81
	EX	4100	3813_{l}	921	225	41	0.82	0.76
	RE	2275	2535_{ijkl}	1940	527	-2	0.46	0.51

Remark: $S(I^*) = 3800$ in the Low-treatments and $S(I^*) = 5000$ in the High-treatments. It holds that $S(I^*) - (2) = (3) + (4) + (5)$. Subscripts indicate that amounts within the second column are significantly different from each other according to a two-sided ranksum test (at the 10% level).

The above findings indicate that when the probability p that separation is efficient is low, parties are best off by entering into a full commitment contract. In contrast, when p is high it is in the parties' joint interest to write no contract at all. Theoretically SP is optimal only in the limit when $p \to 0$, while NC is optimal only when $p \to 1$. Our results suggest that empirically the cutoff values for p making SP and NC optimal respectively, are considerably bounded away from these extreme values. The range of p-values for which it may be optimal to make elaborate contractual arrangements with sophisticated damage payments may thus be much more limited than theory suggests.

For the LI, EX and RE treatments the efficiency levels can also be compared with those achieved in the no-renegotiation setup of Sloof et al. (2003). Interestingly, for all treatments efficiency levels are higher in the latter. Only in the RE-High treatment the difference is small. The explanation for this lies in two observations. First, reliance levels in the no-renegotiation setup are somewhat closer to the efficient levels. The presence of renegotiation typically induces higher reliance levels on average, and thus more overreliance. Second, in the no-renegotiation setup losses due to suboptimal breach decisions appear to be small, while in the current setup we find substantial losses during the bargaining stage. Overall the introduction of ex post renegotiation appears to decrease efficiency.

7 Conclusion

This paper reports the outcomes of a series of laboratory experiments conducted to evaluate the performance of several commonly used breach remedies. These remedies all aim at alleviating the holdup problem that may induce underinvestment in relationship-specific assets. Theory suggests that some of the breach remedies lead to too much protection, as they are predicted to induce overinvestment. This result is driven by two motives to overinvest: the insurance motive and the separation prevention motive.

A previous paper (Sloof et al. 2003) considered breach remedies in a setting that did not allow for ex post renegotiation. There parties could not renegotiate the outcome that resulted after the breach decision stage. The results from this earlier experiment are almost completely in line with the theoretical predictions: under optimally designed liquidated damages reliance is efficient, under expectation damages the insurance motive is indeed present and under reliance damages the separation prevention motive appears to be operative.

In reality it is very unlikely that the interaction between the contracting parties ends with a breach decision when this decision results in an inefficient outcome. A natural and important extension is therefore to give parties the opportunity of ex post renegotiation. This paper does so and tests whether the earlier results found for the different breach remedies carry over to this more realistic context. Apart from that, we also investigate the two benchmark cases of specific performance and no contract. In both these cases sophisticated breach remedies are absent. Either unilateral breach is not possible, or there is simply no contract that can be breached.

We obtain two main findings. First, also in a setting where ex post renegotiations are possible the insurance motive and the separation prevention motive are at work and cause overreliance. Specifically, in line with theoretical predictions the insurance motive is present under expectation damages, reliance damages and specific performance. The separation prevention motive is operative under reliance damages only. Together with those obtained in our earlier experiment these results indicate that the two overinvestment motives are very robust phenomena.

Our second main finding is that there is much less need for compensatory money damages than theory suggests. Under specific performance overinvestment is observed, as is predicted. But, when ex ante separation is likely to be inefficient, the overall inefficiencies observed under this remedy are very small. In this case specific performance outperforms all the sophisticated breach remedies in terms of efficiency, even though theory predicts that liquidated damages would be optimal. In the opposite case where ex ante the probability of efficient separation is high, none of the breach remedies performs better than the no-contract situation. The main reason is that, in the absence of a contract, holdup appears much less of a problem than predicted. This observation is in line with findings from other experimental studies. Taken together, theory predicts that specific performance (no-contract) is optimal only in the limit when the ex ante probability of efficient separation goes to zero (one). Our experimental results indicate that this may hold under a much wider set of circumstances.

In the experiment the probability distribution of outside opportunities is exogenously given (either Low or High). In reality this is not the case, because contracting/trading partners are endogenously chosen. In making their choice parties will look for a contracting partner with whom trade is likely to be efficient. From this perspective our Low treatment is the more realistic and interesting one. The findings for this treatment then point at the attractiveness –i.e. small inefficiency losses– of using specific performance.

Various legal scholars have built a case for the use of specific performance based on efficiency grounds, see Mahoney (2000) and Ulen (1998) for overviews. The theoretical argument used is that in practice compensatory money damages are likely to be under-compensatory. As Ulen (1998) puts it:

> "... in practice, there may be an efficiency advantage for specific performance as the default remedy. This is due to the possibility of court error in accurately computing expectation damages and the current legal limitations on the ability of contracting parties to specify liquidated damages. ... Until we have compelling empirical evidence, the choice between specific performance and legal relief [i.e. compen-

satory money damages], ...turns on one's comparative estimate of the risk of error from parties' failure to reach an efficient outcome under specific performance and the risk of error in a court's estimating damages (plus the costs of litigation)."[28]

In our experiment the informational problems attached to sophisticated breach remedies are absent by construction. Even then it appears that, given *actually observed* behavior, specific performance performs best from an efficiency perspective (in the Low-treatment). We feel that this finding makes the case for specific performance more compelling.

References

Babcock, L. and G. Loewenstein (1997). Explaining bargaining impasse: The role of self-serving biases. *Journal of Economic Perspectives 11*, 109–126.

Bebchuk, L. (2002). Ex ante investments and ex post externalities. Harvard Olin Discussion Paper No. 397.

Che, Y.-K. and T.-Y. Chung (1999). Contract damages and cooperative investment. *Rand Journal of Economics 30*, 84–105.

Croson, R. and J. Johnston (2000). Experimental results on bargaining under alternative property rights regimes. *Journal of Law, Economics and Organization 16*, 50–73.

Edlin, A. and B. Hermalin (2000). Contract renegotiation and options in agency problems. *Journal of Law, Economics and Organisation 16*, 395–423.

Ellingsen, T. and M. Johannesson (2000). Is there a holdup problem? WP No. 357, Stockholm School of Economics.

Hackett, S. (1994). Is relational exchange possible in the absence of reputations and repeated contract? *Journal of Law, Economics and Organization 10*, 360–389.

Hart, O. (1995). *Firms, Contracts and Financial Structure.* Oxford University Press.

Klein, B., R. Crawford, and A. Alchian (1978). Vertical integration, appropriable rents, and the competitive contracting process. *Journal of Law and Economics 21*, 279–326.

Königstein, M. (2001). Hold-up, inefficiency and fairness - An experimental study.

[28] In a similar vein Mahoney (2000) notes: "The relative magnitudes of the inefficiencies generated by costly renegotiation and undercompensation are ultimately empirical questions and to date the literature does not provide data from which we could confidently identify the preferred remedy."

Mahoney, P. (2000). Contract remedies: general. In B. Bouckaert and G. D. Geest (Eds.), *Encyclopedia of Law and Economics.*, Volume III, Chapter 4600, pp. 117–140. Cheltenham: Edward Elgar.

Posner, R. A. (1977). *Economic Analysis of Law* (second ed.). Boston: Little, Brown and Company.

Rogerson, W. (1984). Efficient reliance and damage measures for breach of contract. *Rand Journal of Economics 15*, 39–53.

Segal, I. and M. Whinston (2000). Exclusive contracts and protection of investments. *Rand Journal of Economics 31*, 603–633.

Shavell, S. (1980). Damage measures for breach of contract. *Bell Journal of Economics 11*, 466–490.

Sloof, R. (2000). Finite horizon bargaining with outside options and threat points. Working paper.

Sloof, R., E. Leuven, H. Oosterbeek, and J. Sonnemans (2003). An experimental comparison of reliance levels under alternative breach remedies. *Rand Journal of Economics 34*, 205–222.

Sloof, R., J. Sonnemans, and H. Oosterbeek (2000). Specific investments, holdup, and the outside option principle. *European Economic Review*. forthcoming.

Sonnemans, J., H. Oosterbeek, and R. Sloof (2001). On the relation between asset ownership and specific investments. *Economic Journal 111*, 791–820.

Spier, K. and M. Whinston (1995). On the efficiency of privately stipulated damages for breach of contract: entry bariers, reliance, and renegotiation. *Rand Journal of Economics 26*, 180–202.

Ulen, T. (1998). Specific performance. In *The new palgrave dictionary of economics and the law*. London: Macmillan.

Williamson, O. (1985). The economic institutions of free capitalism. *New York: Free Press*.

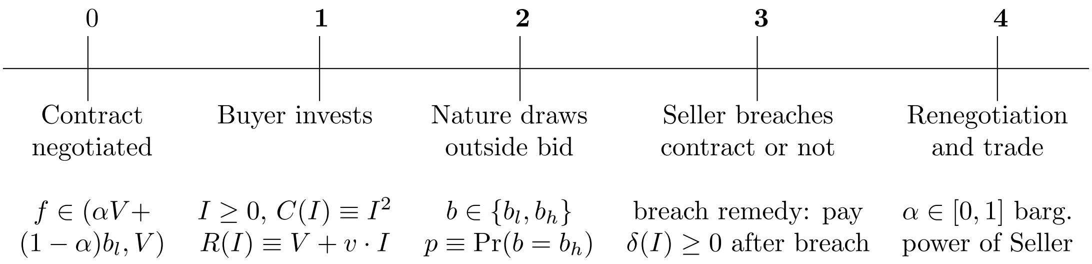


Figure 2: Timing of events in the holdup game

Appendix A

A.1 Description of the model

In this appendix we analyse a more general specification of the holdup game studied in the experiment (cf. Sloof et al. 2003). Buyer can make a specific investment that increases the joint surplus from trade, while Seller has an alternative trading opportunity outside this relationship. In case Buyer and Seller trade gross surplus equals $R(I) \equiv V + v \cdot I$, with $I \geq 0$. Production costs are normalized to zero. Parameter $V > 0$ represents Buyer's basic valuation of trading with Seller, while $v > 0$ gives the constant increment in her valuation with each unit of investment. Investment costs are equal to $C(I) \equiv I^2$. Seller's alternative trading opportunity can either be of low ($b = b_l$) or of high value ($b = b_h$, where $b_l < b_h$). The prior probability that the latter case applies equals $p \equiv \Pr(b = b_h)$. The outside bid b is assumed to be competitive, such that it also represents the outside buyer's valuation of Seller's product.

Figure 2 shows the timing of events. The game starts with the two parties negotiating a contract that governs their relationship. This initial contract specifies trade at a fixed price f. Buyer subsequently chooses the investment level. Then uncertainty about the outside bid is resolved. Knowing the price he can get from the outside buyer, Seller decides whether to breach the contract or not. If he does so he has to pay an amount of $\delta(I)$ in damages to Buyer. In the last stage the parties may renegotiate the outcome that pertains after Seller's breach decision. For instance, they may mutually agree upon lowering the damage payment $\delta(I)$ in order to induce an efficient separation. Parameter α represents the bargaining power of Seller, implying that he receives a fraction of α of the net surplus up for renegotiation. The final trade decision agreed upon determines the payoffs the players obtain.

Our ordering of the breach and renegotiation stage follows Che and Chung (1999) and deviates from Rogerson (1984). The latter paper allows renegotiation only *before* Seller's breach decision. In that case the breach decision is independent of α. In contrast, in our setup the breach decision will be affected by the

Table 10: Setup renegotiation stage

	RS	TP_B	TP_S
No-breach	b	$R(I) - f$	f
Breach	$R(I)$	$\delta(I)$	$b - \delta(I)$

anticipated outcome of the renegotiations, and thus by α. For given parameters the equilibrium outcome may be different for the two orderings. But as Spier and Whinston (1995) show, results with respect to the *optimality* of certain types of damage schedules remain unaffected. The order of play assumed here has two clear advantages. First, it extends the game without renegotiation by adding a final stage rather than fitting in an in-between stage. This makes the present experiment better comparable with the no-renegotiation setup studied earlier. Second, our order of play is also better justified on theoretical grounds. When renegotiation is not possible after the seller's breach decision, this decision may induce an ex post inefficient outcome. But, in a Coasian world in which all gains from trade are exhausted, parties cannot credibly threat not to renegotiate inefficient outcomes (cf. Edlin and Hermalin 2000). As renegotiation is typically introduced to rule out inefficient separations, a model that is based on the threat of such inefficient outcomes can be considered inconsistent.

The renegotiation stage has the following setup. The gross surplus up for renegotiation is denoted RS, the threat point payoffs the players obtain when no agreement is reached equal TP_B and TP_S, respectively. When Seller does not breach the parties may renegotiate this decision to induce separation. In that case RS equals b and the (gross) payoffs under contract performance serve as threat point values. This yields the entries in the first row of Table 10. When Seller breaches the contract the parties may renegotiate to obtain the trade outcome. RS is then equal to $R(I)$ and the (gross) payoffs under breach of contract serve as threat points. The entries in the second row of Table 10 reflect this. This row necessarily applies in the absence of a contract (with $\delta(I) = 0$). Under specific performance breach is not possible and the starting point of the renegotiations is always given by the first row in Table 10.

In line with most of the theoretical literature we do not explicitly consider the contract negotiation stage. We simply assume that a contract specifying f and $\delta(I)$ already exists. For the fixed price f we assume that $\alpha \cdot V + (1-\alpha) \cdot b_l < f < V$. This ensures that both parties can always obtain a payoff from performing the contract that exceeds the payoff they at least obtain in the absence of a contract. The breach remedies listed in the introduction each imply a different damage schedule $\delta(I)$. In particular, we have: $\delta_{LI}(I) \equiv \delta_{LI} \geq 0$, $\delta_{EX}(I) \equiv R(I) - f$, $\delta_{RE}(I) = C(I) = I^2$ and $\delta_{SP}(I) = \infty$. The case in which an initial contract is absent is equivalent with $f = \delta(I) = 0$.[29]

In the presence of renegotiation inefficient separations theoretically do not occur. The focus is therefore on whether the various breach remedies encourage efficient reliance. The efficient level of investment I^* follows from maximizing expected net social surplus $S(I)$, where

$$S(I) \equiv (1-p) \cdot R(I) + p \cdot max\{R(I), b_h\} - I^2$$

The first term follows from our assumption that $b_l < V$, such that trade between Buyer and Seller is always efficient when the outside bid turns out to be low. As shown in Sloof et al. (2003) the efficient investment level is given by $I^* = \frac{1}{2}v$ when $b_h \leq V + \frac{1}{4}(2-p)v^2$ and by $I^* = \frac{1}{2}(1-p)v$ when $b_h \geq V + \frac{1}{4}(2-p)v^2$. In the first case it holds that, for the efficient level of reliance, trade is always efficient. In the second case I^* is such that separation is efficient when b is high. An investor who wants to choose the efficient level then has to take into account that the investment pays off only when $b = b_l$. We take this case as being both the more plausible and the more interesting one. Assumption 1 below is therefore made, together with those reflected in Figure 2 above:

Assumption 1. $b_h > V + \frac{1}{2}v^2$

Assumption 1 is stronger than actually needed; $b_h > V + \frac{1}{4}(2-p)v^2$ would already be sufficient. The stronger assumption is made because it makes the equilibrium analysis easier, without seriously affecting equilibrium predictions.

A.2 Equilibrium predictions

We use backward induction to derive the subgame perfect Nash equilibria. First consider the renegotiation stage. In equilibrium actual renegotiations occur only when Seller's breach decision induces an ex post inefficient outcome. This is the case when the gross renegotiation surplus RS exceeds the sum of the two threat point payoffs $TP_B + TP_S$. The net renegotiation surplus in excess of the threat point payoffs is then split in proportion to the parties' relative bargaining powers: Buyer gets a share of $TP_B + (1-\alpha) \cdot (RS - TP_B - TP_S)$ while Seller obtains the remainder. This corresponds with a generalized split-the-difference rule.

Next consider the breach decision of Seller, given the equilibrium outcome of the renegotiation stage. If $R(I)$ exceeds b, no-breach yields him f while breach gives him $b - \delta(I) + \alpha \cdot (R(I) - b)$. In the opposite case where b exceeds $R(I)$ no-breach gives the seller $f + \alpha \cdot (b - R(I))$ while breach yields him $b - \delta(I)$. When we resolve any indifference in favor of staying in the relation, it is optimal for Seller to breach iff $\alpha \cdot R(I) + (1-\alpha) \cdot b > f + \delta(I)$. (The tie-breaking assumption

[29] In the experiment we have: $V = 1000$, $v = 100$, $f = 600$, $b_l = 0$, $b_h = 7000$, $p_{Low} = \frac{1}{5}$, $p_{High} = \frac{3}{5}$, $\alpha = \frac{1}{2}$ and $\delta_{LI} = 3400$.

Table 11: Equilibrium investment levels

	$\delta(I)$	Case	Investment
NC	0 $(f=0)$		$\frac{1}{2}(1-\alpha)(1-p)v$
SP	∞		$\frac{1}{2}(1-p+\alpha p)v$
LI	δ_{LI}	$\alpha V+(1-\alpha)\,b_l+\frac{1}{2}\alpha(1-p)v^2<f+$ $\delta_{LI}<\alpha V+(1-\alpha)\,b_h+\frac{1}{2}\alpha(1-p)v^2$	$\frac{1}{2}(1-p)v$
EX	$R(I)-f$		$\frac{1}{2}v$
RE	I^2	$p<\frac{4(b_h-V)-2v^2}{4(b_h-V)-(1+\alpha)v^2}$	$\frac{1}{2}v$
		$p\geq\frac{4(b_h-V)-2v^2}{4(b_h-V)-(1+\alpha)v^2}$	$\frac{1}{2}\frac{(1-\alpha p)}{(1-p)}v$
efficient			$\frac{1}{2}(1-p)v$

Remark: For the RE case we have made the additional assumption that $\alpha V+(1-\alpha)b_l+\frac{1}{2}v^2\left(\alpha-\frac{1}{2}\right)<f<\alpha V+(1-\alpha)b_h+\frac{1}{4}v^2\left[\alpha^2-\frac{(1-\alpha)^2}{(1-p)^2}\right]$.

is inessential for our results.) Note that Seller sometimes breaches not with the intention to separate, but rather to get a better deal from Buyer. Likewise, Seller may not breach not because he wants to trade with Buyer, but rather to settle for a lower damage payment through renegotiation.

Given the equilibrium breach decision of Seller, Buyer's equilibrium investment level follows from maximizing $\pi(I)$:

$$\begin{aligned}\pi(I)\equiv\sum_{i=l,h}q_i\cdot\big(\;&\max\left\{(1-\alpha)\cdot[R(I)-b_i]\,,\;0\right\}\;+\\ &\min\left\{R(I)-f-(1-\alpha)\cdot[R(I)-b_i]\,,\;\delta(I)\right\}\;\big)\;-\;I^2\end{aligned}\tag{4}$$

where $q_l\equiv 1-p$ and $q_h\equiv p$. The first max-term represents the gross payoffs without a contract, while the second min-term represents the additional gain from having the contract. The third term simply reflects the investment costs $C(I)$. In Appendix A.3 we derive the equilibrium investment levels for the various specifications of $\delta(I)$ considered. Table 11 summarizes the results.

In the absence of a contract we obtain the well-known underinvestment result (for $\alpha>0$). Breach remedies typically induce overinvestment in relation-specific capital. To assess their relative performance the theoretical literature typically compares them under the assumption of *optimal* contracts; at the contracting stage Buyer and Seller pick a value of f that maximizes their joint surplus.

For these type of contracts, Table 11 confirms the Pareto-ranking as derived by Rogerson (1984): RE≤EX<SP<LI.

Under liquidated damages the equilibrium reliance level depends on the value of δ_{LI}. Three main cases have to be distinguished. First, δ_{LI} is that low such that Seller always breaches. This situation is equivalent to the one without a contract. We thus obtain $I_{LI} = I_{NC}$. Second, δ_{LI} can be that high such that Seller never breaches. This case corresponds with the one of specific performance and we get $I_{LI} = I_{SP}$. Third, δ_{LI} equals an intermediate value such that Seller breaches only when $b = b_h$. Then reliance is predicted to be efficient. Here we focus on this intermediate case. The restriction on $f + \delta_{LI}$ in Table 11 ensures this. The remedy of *efficient expectation damages* that specifies $\delta_{LI} = R(I^*) - f$ fits within this class. It in general constitutes the optimal private damage schedule in a variety of settings (cf. Spier and Whinston 1995).

Under the remaining three breach remedies overinvestment is induced by two motives. The first one is the insurance motive; the breach remedy protects Buyer against separation. Even when separation is efficient ($b_h > R(I)$) and the investment does not pay off from a social point of view, Buyer gets some gross return on her investment. Under specific performance Buyer is only partially insured. Here Seller never breaches, even when it would be socially efficient to do so. In the latter case the parties renegotiate the contract as to make efficient separation possible. The overall return of an additional investment unit is then $\alpha \cdot v$ for Buyer; one extra unit increases her threat point by v, but also lowers the gross surplus up for renegotiation by v. As Buyer bears a share of $(1-\alpha)$ of the reduction in the renegotiation surplus, a return of $\alpha \cdot v$ remains. Hence when $\alpha < 1$ Buyer is not completely insured against separation.

In case of expectation damages Buyer is fully insured against separation. She just chooses the investment level that maximizes her expectancy $R(I) - f$ net of investment costs $C(I)$. The full insurance motive also applies under reliance damages, because Buyer then always recovers at least her investment costs. Yet under this rule there may also be a second motive to overinvest. The intuition behind this separation prevention motive is as follows. When the parties do not trade Buyer obtains a net payoff of zero. She can only get a positive net payoff when separation is inefficient. She therefore may have an additional incentive to overinvest in order to make it so even for $b = b_h$. Whether this is indeed the case depends on the probability p that the latter contingency occurs. (The additional assumption on f is made to rule out border cases.) In case p is low it does not pay for Buyer to affect the outcome after $b = b_h$. Then only the (full) insurance motive to overinvest is present. When p is high it is attractive for Buyer to bear some additional investment costs to generate a positive net payoff when $b = b_h$. Buyer makes such an investment that trade is always efficient, but Seller surely breaches when $b = b_h$. The higher investment yields Buyer a better starting point in the subsequent renegotiations, which are needed to obtain the ex post efficient outcome.

A.3 Derivation of equilibrium reliance levels

No contract: $f \equiv \delta_{NC}(I) \equiv 0$. In expression (4) the min-term vanishes. Clearly then $\frac{\partial \pi(I)}{\partial I} \leq \frac{\partial R(I)}{\partial I} - 2I = v - 2I$. (At the kinks of the max-terms the inequality holds for both the left and the right derivative.) For the equilibrium level of investment it thus necessarily holds that $I \leq \frac{1}{2}v$. Using $b_l < V$ and Assumption 1 expression (4) reduces to $\pi(I) = (1-p) \cdot (1-\alpha) \cdot [R(I) - b_l] - I^2$ for $I \leq \frac{1}{2}v$. Solving for the maximum we obtain $I_{NC} = \frac{1}{2}(1-\alpha)(1-p)v$.

Specific performance: $\delta_{SP}(I) = \infty$. In the min-term of (4) always the first argument applies. Again we get $\frac{\partial \pi(I)}{\partial I} \leq v - 2I$ such that necessarily $I \leq \frac{1}{2}v$. For this range we have $\pi(I) = R(I) - f - p \cdot (1-\alpha) \cdot [R(I) - b_h] - I^2$ under Assumption 1. We directly get $I_{SP} = \frac{1}{2}(1 - p + \alpha p)v$ from maximizing the latter expression.

Liquidated damages: $\delta_{LI}(I) \equiv \delta_{LI} \geq 0$. Because δ_{LI} is independent of I it again follows that $\frac{\partial \pi(I)}{\partial I} \leq v - 2I$. Necessarily then $I \leq \frac{1}{2}v$, and thus $b_l < R(I) < b_h$ at the equilibrium investment level.

The first argument of the min-term in (4) is increasing in b_i. Hence when the first argument applies for b_h, it also necessarily does so for b_l. Three main cases can thus be distinguished. First, assume that the equilibrium investment level is such that the first argument applies for both b_l and b_h. This situation is equivalent to the one under SP and we immediately obtain $I_{LI} = \frac{1}{2}(1-p+\alpha p)v$. To satisfy the assumption made it must hold that $f + \delta_{LI} > \alpha V + (1-\alpha)b_h + \frac{1}{2}\alpha(1-p+\alpha p)v^2$. Second, suppose that for both values of b_i always the second argument δ_{LI} applies. This case is equivalent to the one under NC and we directly get $I_{LI} = \frac{1}{2}(1-\alpha)(1-p)v$. To satisfy the assumption made it is now required that $f + \delta_{LI} < \alpha V + (1-\alpha)b_l + \frac{1}{2}\alpha(1-\alpha)(1-p)v^2$. Third, let the first argument of the min-term apply for b_l and the second one for b_h. Then expression (4) reduces to $\pi(I) = (1-p) \cdot [R(I) - f] + p \cdot \delta_{LI} - I^2$. Maximizing this expression we obtain $I_{LI} = \frac{1}{2}(1-p)v$. For this investment level the assumption on the min-term holds whenever $\alpha V + (1-\alpha)b_l + \frac{1}{2}\alpha(1-p)v^2 < f + \delta_{LI} < \alpha V + (1-\alpha)b_h + \frac{1}{2}\alpha(1-p)v^2$. This is the case considered in Table 11.

Apart from the three main cases two border cases exist. In the first one $I_{LI} = \frac{1}{\alpha v}[f + \delta_{LI} - \alpha V - (1-\alpha)b_l]$, such that for b_l the two arguments in the min-term are equal. This case applies when $\alpha V + (1-\alpha)b_l + \frac{1}{2}\alpha(1-\alpha)(1-p)v^2 < f + \delta_{LI} < \alpha V + (1-\alpha)b_l + \frac{1}{2}\alpha(1-p)v^2$. The condition reflects the requirement that the left (right) derivative of $\pi(I)$ is positive (negative) at the equilibrium reliance level. In the second border case $I_{LI} = \frac{1}{\alpha v}[f + \delta_{LI} - \alpha V - (1-\alpha)b_h]$ and the requirement here reads $\alpha V + (1-\alpha)b_h + \frac{1}{2}\alpha(1-p)v^2 < f + \delta_{LI} < \alpha V + (1-\alpha)b_h + \frac{1}{2}\alpha(1-p+\alpha p)v^2$. The five cases together exhaust all possibilities under the assumptions made.

Expectation damages: $\delta_{EX}(I) = R(I) - f$. Expression (4) simplifies to $\pi(I) = R(I) - f - I^2$, which attains its maximum at $I_{EX} = \frac{1}{2}v$.

Reliance damages: $\delta_{RE}(I) = I^2$. First, assume that the equilibrium investment level is such that the first argument in the min-term of expression (4) strictly applies for both b_l and b_h. This situation is equivalent to the one under SP and we obtain $I_{RE} = \frac{1}{2}(1-p+\alpha p)v$ as equilibrium candidate. To satisfy the assumption made on b_h it must then hold that $\alpha vI + [\alpha V + (1-\alpha)b_h - f] \leq I^2$. Under Assumption 1 (and $f < V$) this necessarily requires $I > \frac{1}{2}v \geq I_{RE}$. Hence this situation is not possible in equilibrium. Second, suppose that for both values of b_i always the second argument I^2 applies. This requires $I^2 \leq \alpha vI + [\alpha V + (1-\alpha)b_l - f]$ and yields $\pi(I)$ strictly increasing in I. But then the requirement cannot be satisfied for the optimal investment level. Hence, necessarily the first (second) argument in the min-term must apply for b_l (b_h). This generates three different situations: (i) the first (second) argument in the min-term applies for b_l (b_h) in an ϵ-neighborhood (with $\epsilon > 0$) around the equilibrium investment level, (ii) the equilibrium level is such that the two arguments are equal for b_l and (iii) the latter applies for b_h. In all three cases $\pi(I) = (1-p)(R(I) - f - I^2) + p(1-\alpha)\max\{R(I) - b_h, 0\}$. The optimum can never be at $R(I) = b_h$, because at that point the right derivative of $\pi(I)$ exceeds the left derivative.

We show that cases (ii) and (iii) are not possible under the assumption made on f. $\alpha V + (1-\alpha)b_l + \frac{1}{2}v^2\left(\alpha - \frac{1}{2}\right) < f$ implies that case (ii) applies for some $I < \frac{1}{2}v$. But then the right derivative of $\pi(I)$ equals $(1-\alpha p)v - 2(1-p)I$, strictly positive for $I < \frac{1}{2}v$. Next, consider case (iii). From the expression for $\pi(I)$ it follows that for the optimum the max-term necessarily must be strictly positive, otherwise $\pi(I)$ falls short of $\pi\left(\frac{1}{2}v\right)$. The left derivative of $\pi(I)$ evaluated at the kink equals $(1-\alpha p)v - 2(1-p)I$, the right derivative equals $v - 2I$. For the left derivative to be positive at $I = \frac{1}{2}\left[\alpha v + \sqrt{\alpha^2v^2 + 4(\alpha V + (1-\alpha)b_h - f)}\right]$ it is then required that $f > \alpha V + (1-\alpha)b_h + \frac{1}{4}v^2\left[\alpha^2 - \frac{(1-\alpha)^2}{(1-p)^2}\right]$.

From the above necessarily case (i) applies. First, suppose $\max\{R(I) - b_h,\ 0\} = R(I) - b_h > 0$ at the optimum. Then we get $I_{RE} = \frac{1}{2}\left[\frac{1-\alpha p}{1-p}\right]v$. To ensure $R(I) - b_h > 0$ it is then required that $b_h < V + \frac{1}{2}\left[\frac{1-\alpha p}{1-p}\right]v^2$. Moreover, for the assumption on the min-term to hold it is needed that $\alpha V + (1-\alpha)b_l < f - \frac{1}{4}v^2\left\{\alpha^2 - \frac{(1-\alpha)^2}{(1-p)^2}\right\} < \alpha V + (1-\alpha)b_h$. Next, assume that $\max\{R(I) - b_h,\ 0\} = 0 > R(I) - b_h$ at the optimum. Then we get $I_{RE} = \frac{1}{2}v$. To ensure $R(I) - b_h < 0$ it is then required that $b_h > V + \frac{1}{2}v^2$, i.e. Assumption 1. The assumptions on the min-term require $\alpha V + (1-\alpha)b_l < f - \frac{1}{2}v^2\left(\alpha - \frac{1}{2}\right) < \alpha V + (1-\alpha)b_h$. Both candidates exist when the additional assumption on f (cf. Remark below Table 11) holds and $b_h < V + \frac{1}{2}\left[\frac{1-\alpha p}{1-p}\right]v^2$. With respect to the expected payoffs we get:

$$\pi\left(\frac{1}{2}\left[\frac{1-\alpha p}{1-p}\right]v\right) = \pi\left(\frac{1}{2}v\right) + p(1-\alpha)\left\{V + \frac{1}{4}\left[\frac{2-p-\alpha p}{1-p}\right]v^2 - b_h\right\}$$

The case distinction in Table 11 follows from the term within $\{\cdot\}$.

Appendix B

Summary of the instructions

Besides the on-line instructions subjects received a summary of these instructions on paper. Below a direct translation of this summary sheet is given. (This summary belongs to the RE-treatments.) Besides the summary sheet all participants received two additional sheets: one with the costs table and one with 21 specific tables reflecting the round-amount and the base-amounts for each specific value of $T \in \{0, 5, .., 100\}$. These sheets are also included (for the RE-treatments).

In the experiment the choice of T corresponds with the investment choice, the round-amount reflects the gross surplus up for renegotiation, and the base-amounts correspond to the threat point payoffs of Buyer (subject A) and Seller (Subject B) respectively. The color that applies in a particular period represents the value of the outside bid: blue corresponds with $b = 0$, while yellow corresponds with $b = 7000$. Finally, the third stage reflects the choice between no-breach (option X) and breach (option Y).

Summary of the instructions This experiment consists of 12 periods. At the start of each period the participants are paired in couples. One of the participants in a pair has role A, the other has role B. What exactly your role is you will hear at the start of each of period. Overall you will be assigned the role of A six times and the role of B also six times. You are never paired with the same other participant in two consecutive periods. Whenever you meet the same participant again is unpredictable. With whom you are paired within a particular period is always kept secret from you.

Each period consists of four stages. In the first stage the participant with role A chooses the amount T (a multiple of five between 0 and 100). This choice costs participant A an amount of $4 \cdot T^2$ points. In the second stage a disk is turned around to determine whether the color in this period is yellow or blue. In the third stage the participant with role B chooses between X and Y. The amount T, the color (yellow or blue) and the choice between X and Y together determine which round-amounts and base-amounts apply in stage 4. The table below makes this clear.

	Blue		Yellow	
	X	Y	X	Y
Round-amount	0	$1000 + 100 \cdot T$	7000	$1000 + 100 \cdot T$
Base-amount A	$400 + 100 \cdot T$	T^2	$400 + 100 \cdot T$	T^2
Base-amount B	600	$-T^2$	600	$7000 - T^2$

In stage 4 A and B have to divide four equally sized round-amounts. They alternate in making proposals until either a proposal is accepted or until four rounds are over. In the first round of stage 4 the participant with role B makes a proposal. The amount B asks for himself has to lie between $-11,000$ and $11,000$ points. This proposal applies to the round-amount of round 1 and *also* to the round-amounts in rounds 2 up to 4. In case A accepts the proposal, the round-amounts of rounds 1 through 4 are divided according to this proposal. When A rejects the proposal of B, both participants obtain their base-amount and participant A makes a new proposal. This proposal now concerns the round-amounts of rounds 2 up to 4. This process continues until the fourth round is reached. In case B rejects the proposal of A in the fourth round, participant B cannot make a new proposal.

Before B makes the first proposal, both A and B have to indicate whether or not they want to participate in the four rounds. In case at least one of them does not want to do so, the four proposal-rounds do not take place and both participants obtain four times their individual base-amount.

The payoffs of participant B in a particular period equal four times the base-amount of B when in stage four the subjects within a pair decide not to participate in the four rounds. Otherwise the payoffs of B equal the payoffs from the four proposal rounds. These payoffs consist of round-amounts and/or base-amounts, dependent on when a proposal is accepted.

The gross payoffs of participant A are determined in the same way. The net payoffs of A are obtained by subtracting, from the gross payoffs, the costs made in stage 1. (For participant B there is no difference between gross and net payoffs.)

During the experiment the probabilities that the disk points at yellow and blue change. In periods 1 through 6 the probability of obtaining yellow equals 60% (the probability of blue is then 40%). In periods 7 through 12 the probability of obtaining yellow equals 20% (the probability of blue is then 80%). In each period you can find the probabilities of obtaining yellow and blue on your screen. Moreover, it will be verbally announced when these probabilities change.

At the start of the experiment you receive $30,000$ points for free. At the end of the experiment you will be paid in guilders, based on the total number of points you earned. The conversion rate is such that 2200 points in the experiment correspond to one guilder in money.

COSTS FOR PARTICIPANT WITH ROLE A
FOR EACH FEASIBLE AMOUNT OF T

Amount T	Costs for participant A
0	0
5	100
10	400
15	900
20	1600
25	2500
30	3600
35	4900
40	6400
45	8100
50	10,000
55	12,100
60	14,400
65	16,900
70	19,600
75	22,500
80	25,600
85	28,900
90	32,400
95	36,100
100	40,000

SPECIFIC TABLES WITH ROUND-AMOUNTS AND BASE-AMOUNTS
FOR EVERY FEASIBLE AMOUNT OF T

	blue		*yellow*	
T=0	X	Y	X	Y
round-amount	0	1000	7000	1000
base-amount A	400	0	400	0
base-amount B	600	0	600	7000

	blue		*yellow*	
T=5	X	Y	X	Y
round-amount	0	1500	7000	1500
base-amount A	900	25	900	25
base-amount B	600	-25	600	6975

	blue		*yellow*	
T=10	X	Y	X	Y
round-amount	0	2000	7000	2000
base-amount A	1400	100	1400	100
base-amount B	600	-100	600	6900

	blue		*yellow*	
T=15	X	Y	X	Y
round-amount	0	2500	7000	2500
base-amount A	1900	225	1900	225
base-amount B	600	-225	600	6775

	blue		*yellow*	
T=20	X	Y	X	Y
round-amount	0	3000	7000	3000
base-amount A	2400	400	2400	400
base-amount B	600	-400	600	6600

	blue		*yellow*	
T=25	X	Y	X	Y
round-amount	0	3500	7000	3500
base-amount A	2900	625	2900	625
base-amount B	600	-625	600	6375

	blue		*yellow*	
T=30	X	Y	X	Y
round-amount	0	4000	7000	4000
base-amount A	3400	900	3400	900
base-amount B	600	-900	600	6100

	blue		*yellow*	
T=35	X	Y	X	Y
round-amount	0	4500	7000	4500
base-amount A	3900	1225	3900	1225
base-amount B	600	-1225	600	5775

	blue		*yellow*	
T=40	X	Y	X	Y
round-amount	0	5000	7000	5000
base-amount A	4400	1600	4400	1600
base-amount B	600	-1600	600	5400

	blue		*yellow*	
T=45	X	Y	X	Y
round-amount	0	5500	7000	5500
base-amount A	4900	2025	4900	2025
base-amount B	600	-2025	600	4975

	blue		*yellow*	
T=50	X	Y	X	Y
round-amount	0	6000	7000	6000
base-amount A	5400	2500	5400	2500
base-amount B	600	-2500	600	4500

	blue		*yellow*	
T=55	X	Y	X	Y
round-amount	0	6500	7000	6500
base-amount A	5900	3025	5900	3025
base-amount B	600	-3025	600	3975

	blue		*yellow*	
T=60	X	Y	X	Y
round-amount	0	7000	7000	7000
base-amount A	6400	3600	6400	3600
base-amount B	600	-3600	600	3400

	blue		*yellow*	
T=65	X	Y	X	Y
round-amount	0	7500	7000	7500
base-amount A	6900	4225	6900	4225
base-amount B	600	-4225	600	2775

	blue		*yellow*	
T=70	X	Y	X	Y
round-amount	0	8000	7000	8000
base-amount A	7400	4900	7400	4900
base-amount B	600	-4900	600	2100

	blue		*yellow*	
T=75	X	Y	X	Y
round-amount	0	8500	7000	8500
base-amount A	7900	5625	7900	5625
base-amount B	600	-5625	600	1375

	blue		*yellow*	
T=80	X	Y	X	Y
round-amount	0	9000	7000	9000
base-amount A	8400	6400	8400	6400
base-amount B	600	-6400	600	600

	blue		*yellow*	
T=85	X	Y	X	Y
round-amount	0	9500	7000	9500
base-amount A	8900	7225	8900	7225
base-amount B	600	-7225	600	-225

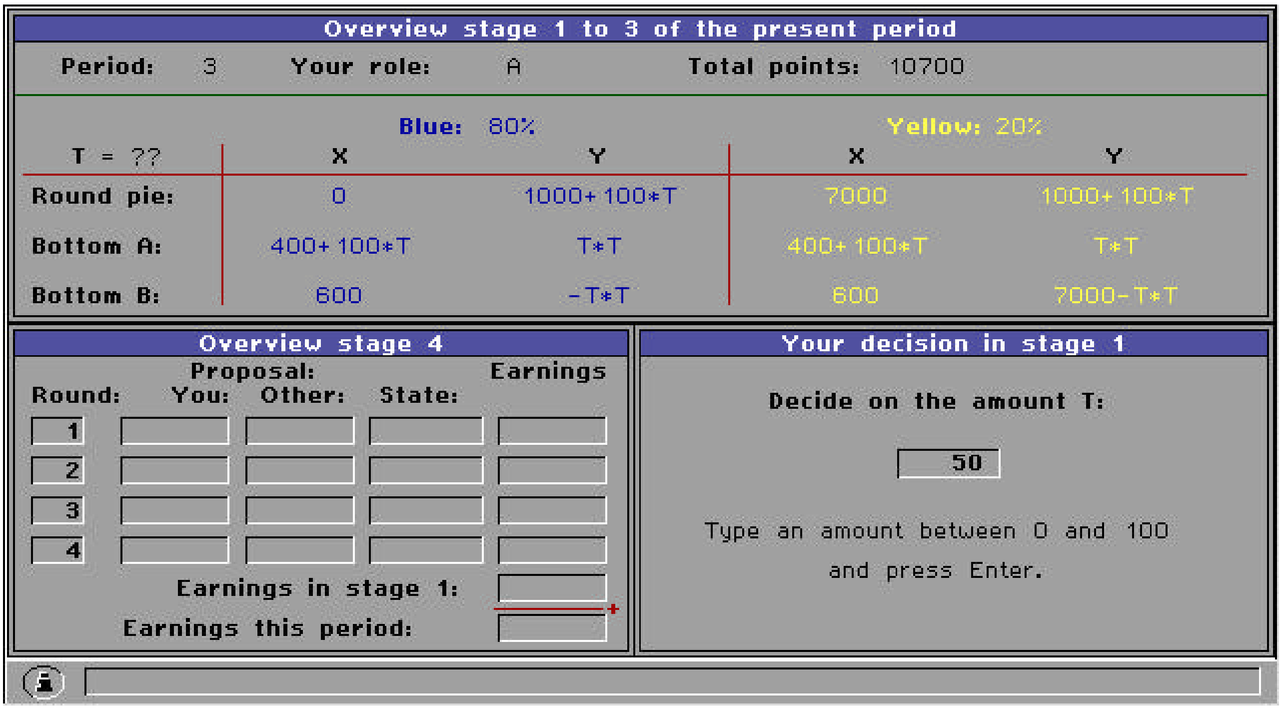
	blue		*yellow*	
T=90	X	Y	X	Y
round-amount	0	10000	7000	10000
base-amount A	9400	8100	9400	8100
base-amount B	600	-8100	600	-1100

	blue		*yellow*	
T=95	X	Y	X	Y
round-amount	0	10500	7000	10500
base-amount A	9900	9025	9900	9025
base-amount B	600	-9025	600	-2025

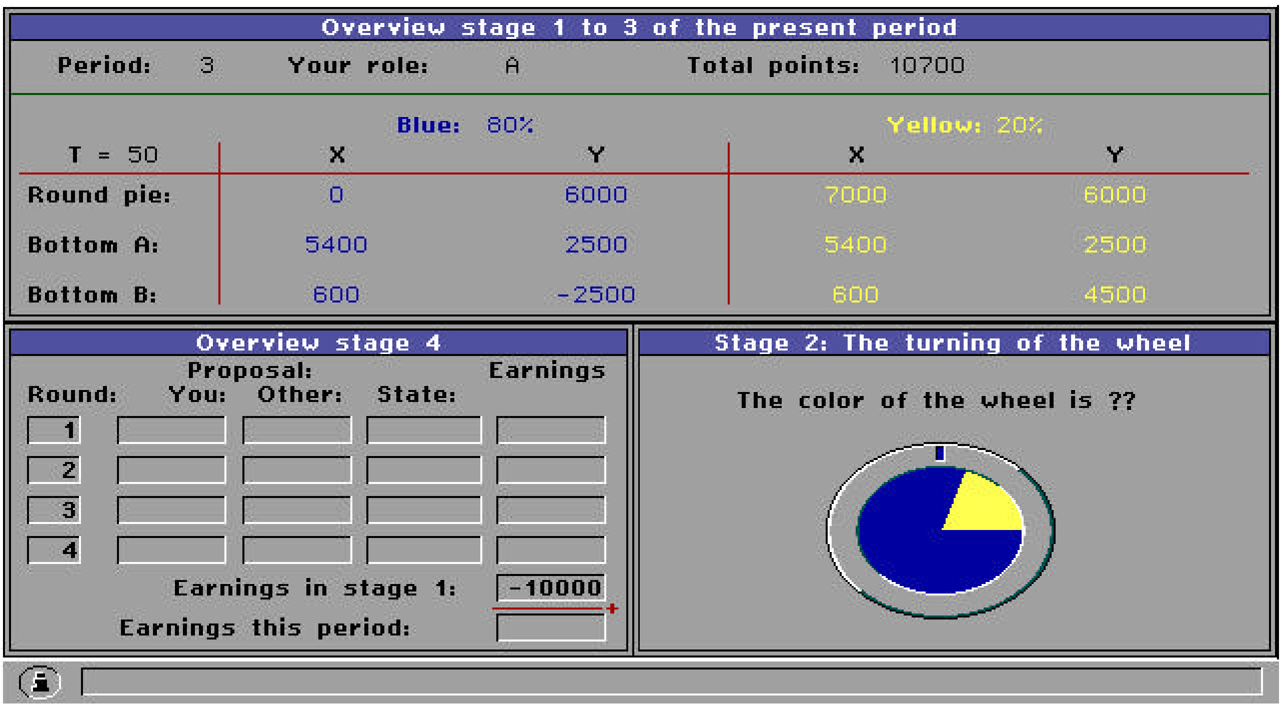
	blue		*yellow*	
T=100	X	Y	X	Y
round-amount	0	11000	7000	11000
base-amount A	10400	10000	10400	10000
base-amount B	600	-10000	600	-3000

Appendix C

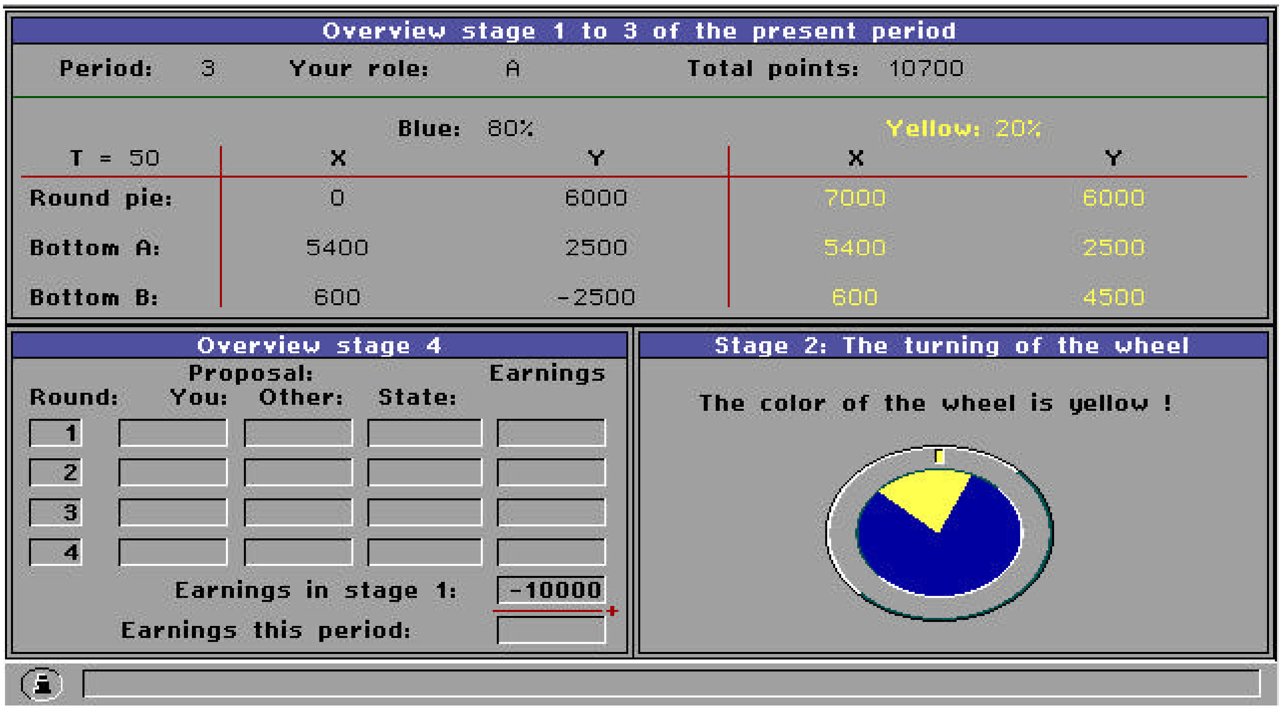
This appendix contains translations of the computer-screens Buyers faced during the experiment. The example concerns the four-stage game of Section 2 for the case of reliance damages. In the simpler games of Section 5 the third stage is left out.



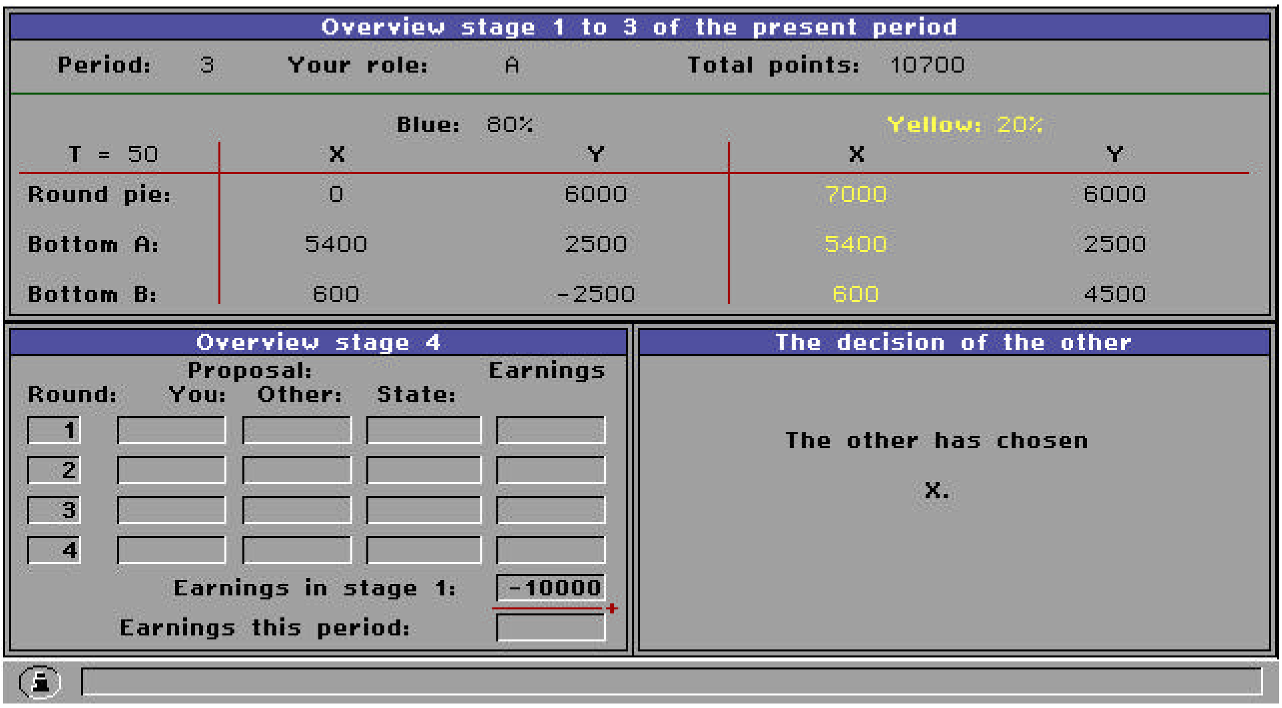
In the experiment Buyer has code 'A' and Seller code 'B'. In the overview at the top of the screen the pie sizes ('Round pie') and the threat points ('Bottom') are presented as formulas. When the subject enters the investment T in stage 1, these formulas are replaced by numbers and the subject has to confirm or change the decision (not shown here).



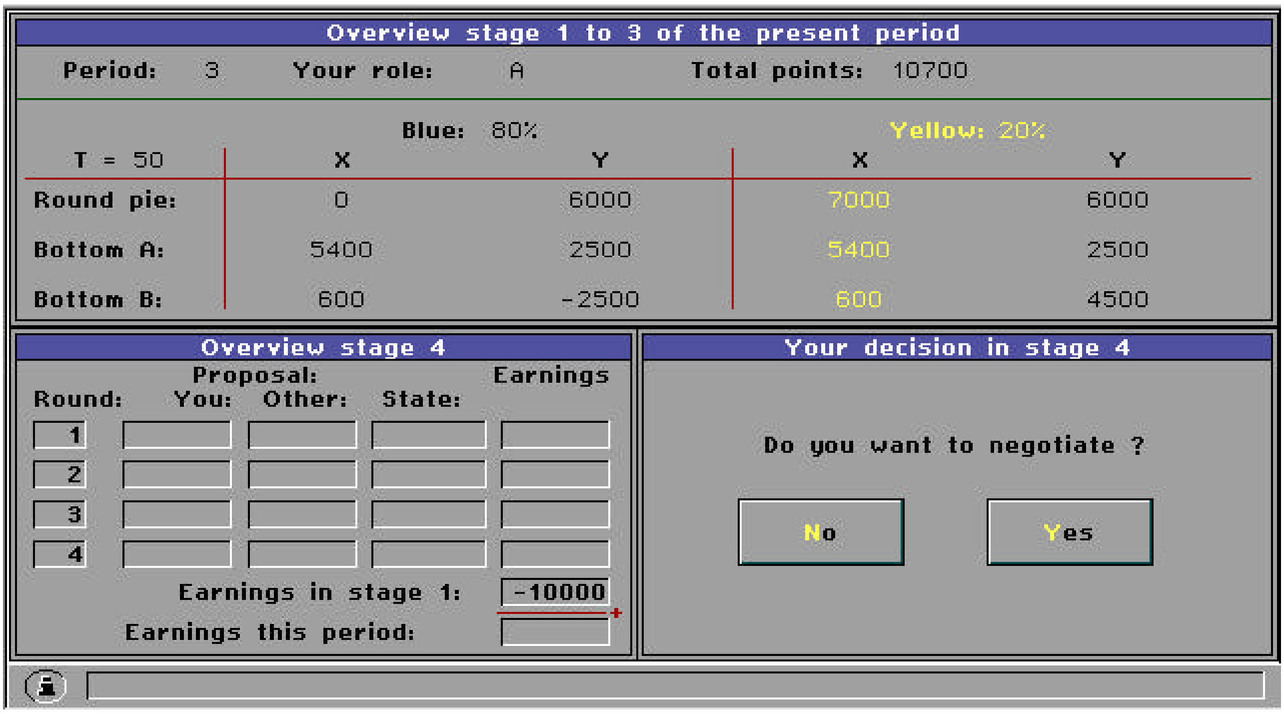
After the confirmation the wheel of fortune spins...



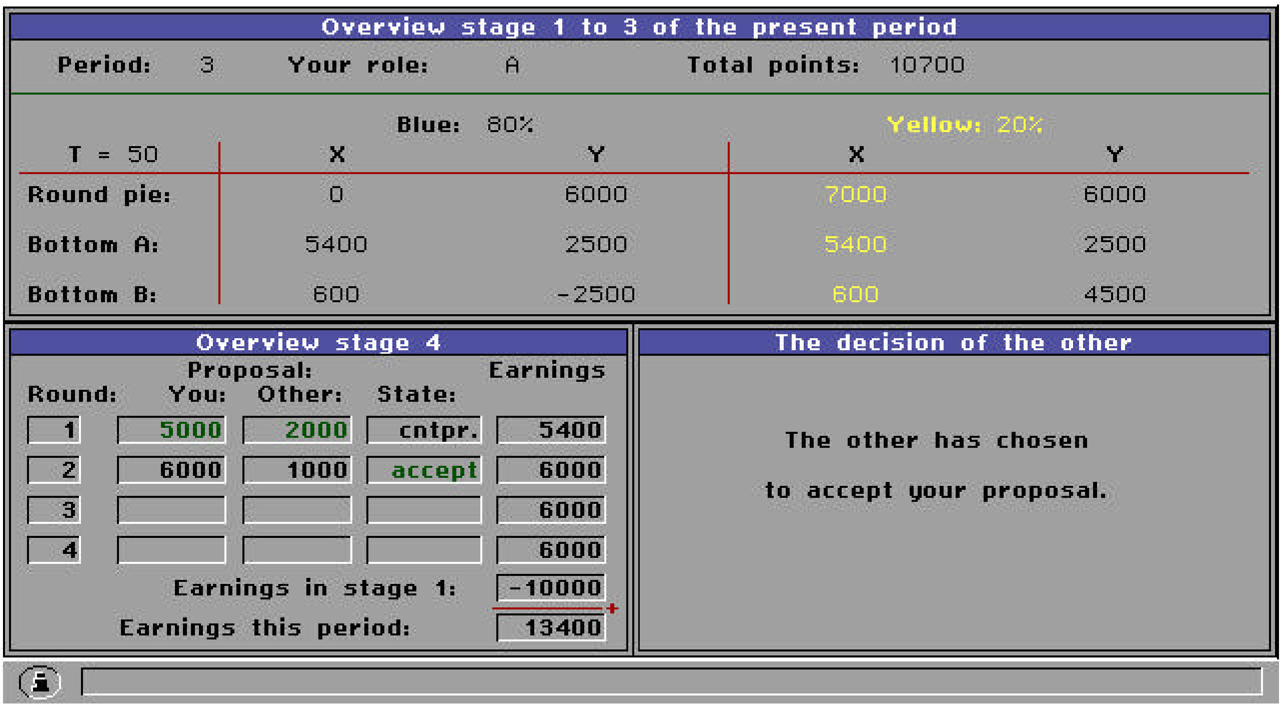
The outcome of the wheel of fortune is presented in the overview at top of the screen; the now irrelevant blue numbers have turned grey.



When Seller (B) has chosen 'X' (No Breach) the now irrelevant yellow numbers under 'Y' have turned grey. (In the three-stage game of Section 5 this stage is absent; without a contract always case ‘Y’ applies (with the then appropriate numbers), under specific performance always case ‘X’ applies.)



At the start of the final stage both subjects are asked whether they want to negotiate.



If both are willing to negotiate, the B-player (Seller) formulates the first proposal. The actions of the other player are always displayed in green while own actions always appear in black. Negotiations end when a proposal is accepted, or the fourth proposal is rejected.