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Reference Points, Social Norms, and Fairness in Contract Renegotiations*

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Abstract: How does an ex ante contract affect behavior in an ex post renegotiation game? We address this question in a canonical buyer-seller relationship with renegotiation. Our paper provides causal experimental evidence that an initial contract has a highly significant and economically important impact on renegotiation behavior that goes beyond the effect of contracts on bargaining threat points. We compare situations in which an initial contract is renegotiated to strategically equivalent bargaining situations in which no ex ante contract was written. The ex ante contract causes sellers to ask for markups that are 45% lower than in strategically equivalent bargaining situations without an initial contract. Moreover, buyers are more likely to reject given markups in renegotiations than in negotiations. These effects do not depend on whether the contract was written under competitive or monopolistic conditions. Our results provide strong evidence supporting the hypothesis that contracts serve as reference points that shape and coordinate the expectations of the contracting parties.

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1. Introduction

When parties write a long-term contract they have to take into account that the contract may have to be renegotiated in states of the world in which the initial contract gives rise to an inefficient allocation. An important question is how the initial contract affects behavior in the renegotiation game. Neoclassical contract theory argues that the only effect of the initial contract is to define the threat points in renegotiation. If renegotiation fails, each party can insist that the initial contract is carried out.[1] Rational parties anticipate this and design the ex ante contract so as to give optimal incentives for relationship specific investments or to provide optimal insurance.

In recent years new approaches have been developed that point out additional effects of contracts on renegotiation behavior. These approaches build on behavioral regularities that are well documented in behavioral economics and psychology. Some papers claim that a contract serves as a reference point. When the contracting parties, say a buyer and a seller, renegotiate a contract they compare the renegotiation outcome to the outcome prescribed by the contract. Hart and Moore (2008) argue that these comparisons are distorted by self-serving biases that may lead to aggrievement and shading.[2] They further hypothesize that the impact of the initial contract on behavior is stronger if the contract was formed under competitive conditions. Herweg and Schmidt (2013) point to loss aversion when the parties compare the renegotiation outcome to the initial contract. Loss aversion drives a wedge between the buyer's valuation and the seller's cost and makes the renegotiation outcome sticky and inefficient. Other papers argue that concerns for fairness affect the renegotiation outcome. For example, outcome-based models of social preference (e.g. Fehr and Schmidt, 1999) imply that the division of the surplus depends on the initial price. If the initial price is high, the seller will get less of the renegotiation surplus than if the initial price is low. Finally, some papers point to the role of legal rules and social norms. Hart and Moore (2008) refer to the legal literature that says that the parties to a contract are obliged to renegotiate in "good faith," which prevents the seller from raising the price ex post if this cannot be objectively justified. Furthermore, Hart and Moore argue that legal principles are often supported by social norms that shape behavior even if there are no courts in the background. This latter point is supported by Iyer and Schoar (2013) who argue that there is a social norm that constrains the renegotiation offers of the sellers. All of these theories imply that the renegotiation

[1] See, e.g., Grossman and Hart (1986) and Hart and Moore (1988).
[2] See also Hart (2009), Hart and Holmström (2010), and Halonen-Akatwijuka and Hart (2013) for different flavors of this argument.

outcome does not depend on outside options alone. However, they have different implications for the renegotiation outcome, which in turn has important implications for the design of optimal contracts ex ante.[3]

In this paper we report on an economic experiment that allows us to discriminate between the different theories and to assess the statistical (and economic) significance of the effects that they predict for renegotiation behavior. We consider a canonical contracting situation under tightly controlled conditions. Two parties can write an initial contract that fixes the specification and the price of a good to be traded at some future date. Then an ex ante uncertain state of the world materializes. With some probability the realized state requires a different specification of the good than the one the parties agreed upon initially. In this case the parties can renegotiate the initial contract. If renegotiation fails, the initial contract is carried out. This contracting and renegotiation game is played 24 times by the subjects, in each round against a newly matched, anonymous opponent. In each round the cost of the seller to adjust the specification of the good to the realized state of the world differs. In some rounds the cost of the seller to produce the efficient good is higher than the cost to produce the good specified in the contract, sometimes the cost is lower. Both parties perfectly observe the buyer's value and the seller's cost when they renegotiate. This provides a rich experimental set-up that allows us to test the predictions implied by the different theories and to discriminate between them. To do so we look at two treatment variations.

First, we compare the Contract Treatment (CT) described above to a No Contract Treatment (NCT) that is identical to CT except for the initial contract. In NCT the buyer and the seller meet only after the state of the world has materialized and negotiate how to split the surplus from trading the efficient good. If negotiations fail each party gets an exogenously assigned outside option payoff. The outside options in NCT are, by design, exactly the same as the outside options in CT that were generated endogenously by the initial contract. Also the surplus that can be generated in the renegotiation game and in the bargaining game, respectively, is identical. Thus, from a standard game theoretic perspective the strategic situation and the material payoffs of the renegotiation game in CT and of the bargaining game in NCT are identical. If we observe that parties behave differently in CT as compared to NCT it cannot be due to the threat point

[3] The implications for ex ante contracts are spelled out in detail in Hart and Moore (2008), Hart (2009), Hart and Holmström (2010), and Herweg and Schmidt (2013).

effect, contradicting the neoclassical view of renegotiation. In this case the initial contract must have additional, behavioral effects.

Second, we study the effects of competition. In CT the seller is a monopolist who can make a take-it-or-leave-it offer for the initial contract to the buyer. In the Contract and Competition Treatment (CT&COMP) there are two sellers competing with each other. At the renegotiation stage the winning seller is in a bilateral relation with the buyer, exactly as in the renegotiation stage of CT. Hart and Moore (2008) predict that if there is ex ante competition the initial contract has a stronger impact on expectations and entitlements than if there is no competition ex ante. To test this hypothesis we conduct a simple diff-in-diff analysis: We compare the difference in prices between CT and NCT to the difference in prices between CT&COMP and a No Contract and Competition Treatment (NCT&COMP). In NCT&COMP no initial contract exists and the exogenously assigned outside options in the bargaining game are, by design, the same as the endogenously determined outside options in the renegotiation stage of CT&COMP (constructed in the same way as in NCT).

We find strong and highly significant treatment effects. First, the markups[4] charged by the sellers in the two Contract Treatments are much lower than the markups charged in the corresponding No Contract Treatments, even though the strategic situation and the monetary payoffs of the contracting parties are identical in the corresponding treatments. Likewise, buyers are less likely to accept any given markup in the two Contract treatments. However, the overall rejection rate is not significantly different in CT than in NCT because sellers ask for lower markups in CT. These findings are inconsistent with neoclassical contract theory and also with a model of purely outcome based social preferences, but they are consistent with the idea that contracts serve as reference points as spelled out in Hart and Moore (2008) and Herweg and Schmidt (2013).

Furthermore, Hart and Moore (2008) argue that an initial contract that was formed under more competitive conditions provides a more objective measure of the entitlements of the parties and therefore is a stronger reference point. This implies that markups should be smaller if there is competition for the initial contract than if it was imposed by a monopolistic seller. Thus, Hart and Moore (2008) predict that the difference between markups in CT&COMP and NCT&COMP should be larger than the difference between CT and NCT. However, we find that, if anything,

[4] In the Contract Treatments, the markup is defined as the change in price compared to the initial price. In the No Contract Treatments, the markup is defined as the change in price relative to an exogenously given price that is identical to the price offer in the Contract Treatments.

the difference with competition is smaller. There is also no effect of competition on the acceptance rate for any given markup. Hence, competition does not strengthen the reference point effect. Put differently, these results show that competition is not necessary for the reference point effect. Even if a contract is not written under competitive conditions it has a strong effect on renegotiation behavior.

However, the prices agreed upon in the initial contract are much lower with competition than without. We find that sellers try to compensate for the low initial prices in the Competition Treatments by making much more aggressive (re)negotiation offers than in the No Competition Treatments, even though the surplus that can be generated in the (re)negotiation games is identical. Buyers accept this behavior. They are willing to accept much higher markups if the initial price was low than if the initial price was high. Thus, despite the much more aggressive (re)negotiation behavior of sellers in the Competition Treatments there is no significant difference in the overall acceptance rates between treatments with and without competition. This is consistent with theories of fairness and outcome based social preferences.

Finally we find that a significant minority of sellers is willing to deliver the efficient good without charging a markup in CT, but only if the cost of doing so is lower than the cost of sticking to the initial contract. This finding is consistent with the claim that good faith and social norms constrain markups in renegotiations to be objectively justifiable (e.g., by increased costs). However, in CT&COMP this effect largely disappears. Because the initial prices are very low with competition almost all sellers use the renegotiation game to increase the price. Thus, we find limited support for the presence of a social norm against price gauging if the initial contract was concluded under competitive conditions.

The rest of the paper is organized as follows. Section 2 discusses the relation of our paper to the literature. Section 3 describes the experimental set-up. In Section 4 we summarize the theoretical predictions of the different models of renegotiation. Section 5 reports the experimental results. Section 6 concludes.

2. Discussion of the Literature

Our paper is closely related to a series of papers by Fehr, Hart and Zehnder (2009, 2011, 2014) that experimentally test the specific predictions of the Hart and Moore (2008) model. In Hart and Moore (2008) the contracting parties can either write a rigid or a flexible at-will-contract. The flexible contract allows the parties to adjust the contract to the realization of the state of world.

However it may give rise to conflicting expectations. Each party expects to get the best possible outcome that the flexible contract allows for. If a party gets less, it feels aggrieved and shades on performance which is inefficient and reduces the payoff of the other party.

Fehr, Hart and Zehnder (2011) design an experiment that closely follows the specific set-up of the Hart and Moore (2008) model. The experimental results show that flexible contracts give rise to more "shading" than rigid contracts, which makes rigid contracts more profitable for the buyers. Fehr, Hart and Zehnder (2009) discuss the role of competition by comparing the original experiment to a control treatment in which the contract is not written under competitive conditions but rather imposed exogenously on the parties. They show that the difference in shading between flexible and rigid contracts disappears in the control treatment. However, the control treatment differs in two dimensions from the original experiment. There is no competition and there is no voluntary agreement to the terms of the contract. Thus, it is not clear whether it is competition or voluntary agreement that is driving the treatment effect.

Fehr, Hart and Zehnder (2014) ask whether the tradeoff between flexibility and shading disappears if the parties can renegotiate the rigid contract. They consider a very specific form of renegotiation, called "repudiation," where the buyer can change the price of the contract unilaterally (without asking for the seller's agreement). They show that the basic tradeoff between flexibility and shading is not affected by the possibility of repudiation. In another treatment Fehr, Hart and Zehnder (2014) give the buyer the opportunity to announce what prices he wants to set in the different states of the world. This announcement is voluntary and not binding. They find that the announcement helps to coordinate expectations and to reduce the amount of shading under flexible contracts, but the basic tradeoff is still visible and significant.

Brandts, Charness and Ellman (2013) consider a slightly different experiment in which the terms of the initial contract are negotiated by the two parties, while they are determined by a competitive mechanism in Fehr, Hart and Zehnder (2011). Brandts et al. first replicate the result that structured communication has a small positive effect on the performance of flexible contracts. Then they consider a treatment with free communication. With free communication flexible contracts are much more efficient than rigid contracts and they are chosen considerably more often.[5]

[5] Erlei and Reinhold (2011) point out that if the buyer chooses a rigid contract in the FHZ (2011) experiment then the price is driven down by competition and the seller gets almost nothing of the surplus. If the buyer wants to give some of the surplus to the seller he must opt for a flexible contract and use the flexibility to increase the price. Thus, a rigid contract may trigger negative reciprocity while a flexible contract may be perceived as a signal of fairness. They

All these papers compare flexible and rigid contracts and study under what conditions flexible contracts give rise to shading. They consider at-will-contracts and show that there is indeed a tradeoff between flexibility and shading. However, none the papers considers renegotiation of a specific performance contract, nor do they allow discriminating between different theories of ex post inefficient behavior.

Our paper is also related and complementary to a field experiment by Iyer and Schoar (2013). They sent trained auditors acting as customers to tailors in Chennai in Southern India. The customers place orders to have a garment stitched. A short while thereafter the customer returns to the tailor and asks for expedited stitching of the garment within one day because of an urgency. Iyer and Schoar find that tailors do not use this situation to renegotiate the price even if the customer mentions that he is out of state (and therefore no repeat customer). This contradicts neoclassical contract theory predicting that sellers will exploit the hold-up situation to increase the price. While this field experiment provides strong external validity it cannot discriminate between different explanations for the observed behavior. In our lab experiments, in contrast, we can tightly control the conditions under which renegotiations take place and thereby discriminate between different theories.[6]

Hoppe and Schmitz (2011) report on a laboratory experiment in which option contracts can be used as a remedy to solve the hold-up problem. Standard theory predicts that option contracts are useless if they can be renegotiated. However, Hoppe and Schmitz show that option contracts still have an effect even with renegotiation, which is consistent with our experimental findings. In Hoppe and Schmitz (2011) the terms of the option contract are exogenously given, while we consider standard specific performance contracts the terms of which are endogenously negotiated by the contracting parties. Furthermore, their experiment cannot be used to discriminate between different theories that are consistent with the observed behavior, while our experimental set-up enables us to do this by varying the seller's costs of delivery and the degree of competition under which the initial contract is concluded.

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offer support for this hypothesis by comparing the original FHZ (2011) experiment to a control experiment in which contracts are assigned exogenously.

[6] In another field experiment, Iyer and Schoar (2010) study the reaction of wholesalers of custom-made pens in India when they are faced with a hold-up situation. They find that these wholesalers often refuse to renegotiate the price even if they lose a valuable contract. This is reminiscent of the higher rejection rates for given markups in our Contract Treatments as compared to the No Contract Treatments.

3. Experimental Design and Procedures

The experiment considers a trading relationship between a buyer and a seller with the following framing. The parties want to trade a good next week, but they do not know yet what the optimal day for delivery is. If the good is delivered on the "right day," the buyer's valuation of the good is v=100; if it is delivered on the "wrong day" the buyer's valuation is v=50. The parties know that Wednesday is the right day with 40% probability. The right day may, however, also be any of the other four workdays, each with probability 15%. The parties must write a contract that specifies the day of delivery before the right day is known, but they are aware that the contract can be renegotiated.

If the good is delivered on Wednesday, the seller's cost is c=20. If the good is delivered on some other workday the seller's cost is a random variable drawn from [0,40] with $E(c)$=20, i.e. the cost may be higher or lower than 20.[7]

The time structure of the Contract Treatment (CT) is as follows:

Stage 0: A buyer and a seller are randomly matched. The seller makes a take-it-or-leave-it price offer p for delivery on Wednesday. The buyer may accept or reject this contract. In case of rejection both parties get a payoff of 0 and the game ends. If the buyer accepts the game moves on.

Stage 1: Both parties learn the right day and the seller's cost of delivery on that day. If the right day is Wednesday, the contract is executed and the game ends. In this case monetary payoffs are $M^S = p - 20$ for the seller and $M^B = 100 - p$ for the buyer. If Wednesday is not the right day, the buyer can ask the seller to change the day of delivery to the right day. If the buyer does not ask for a change of the day of delivery or if the seller insists to deliver on Wednesday, the contract is executed and the game ends. The resulting payoffs are $M^S = p - 20$ for the seller and $M^B = 50 - p$ for the buyer.

Stage 2: If the buyer asks for a change of the day of delivery and if seller is in principle willing to comply with the request, the parties enter the renegotiation game in which the seller has two options:

[7] We predetermined the sequence of "right days" and the cost realizations on the "wrong days." Wednesday was not the right day in 15 out of 24 periods and the realized costs took the following values: 0 (2x), 10 (2x), 18 (2x), 20 (3x), 22 (2x), 30 (2x), 40 (2x).

1. He can deliver the good on the right day at the price specified in the initial contract, i.e. without asking for a markup. In this case the buyer does not have to make an acceptance decision as the markup is zero, and the seller's payoff is $M^S = p - c$, while the buyer gets $M^B = 100 - p$.
2. He can make a take-it-or-leave-it renegotiation offer to the buyer, proposing to deliver the good on the right day if the price is changed to $p+m$, where m is a markup that may be positive or negative. If the buyer accepts the offer, payoffs are $M^S = p + m - c$ and $M^B = 100 - p - m$. If the buyer rejects, the initial contract is executed: the good is delivered on Wednesday and payoffs are $M^S = p - 20$ and $M^B = 50 - p$.

Subjects play this game repeatedly for 24 rounds under a stranger matching protocol.

We compare the Contract Treatment to a No Contract Treatment (NCT) in which the parties do not write an initial contract. Parties meet only after the state of the world has materialized. We designed this treatment such that the renegotiation game in CT at Stage 2 and the bargaining game in NCT have exactly the same structure. Thus, we assign the outside options of the buyer and the seller in NCT as follows: For each buyer-seller pair in CT the price p in the initial contract gives rise to a threat point $\left(\underline{M}^B = 50 - p, \underline{M}^S = p - 20\right)$ in the renegotiation game. We assign this threat point exogenously to the corresponding buyer-seller pair in NCT. Also, the surplus that can be generated is identical in the renegotiation game in NCT and the bargaining game in CT.[8] As at Stage 2 in CT, the seller has two options if he wants to trade in NCT:

1. In each round, there is an exogenously given price that is identical to the initial offer price p of the corresponding buyer-seller pair in CT. The seller can deliver the good without changing the exogenously given price p. In this case – as in the equivalent case in CT – the buyer does not have to make an acceptance decision because his payoff is simply 50 points higher than his outside option. The seller's monetary payoff then is $M^S = p - c$, while the buyer gets $M^B = 100 - p$.

[8] We used the same matching protocol in CT and in NCT. Furthermore, the sequence of the right day and the cost realization on the right day was the same in all sessions. Thus, if seller *s* is matched to buyer *b* in round *t* of session *j* in CT and his offer $\tilde{p}$ is accepted, then there exists a pair of seller *s'* and buyer *b'* in session *j* of NCT that has (i) the exogenously assigned outside options $\underline{M}_t^S = \tilde{p} - 20$ and $\underline{M}_t^B = 50 - \tilde{p}$ and (ii) the same opportunity for increasing the joint surplus in round *t*.

2. He can make a take-it-or-leave-it offer to the buyer, proposing to deliver the good at price $\hat{p}$. If the buyer accepts the offer, the monetary payoffs are $M^S = \hat{p} - c$ and $M^B = 100 - \hat{p}$. If the buyer rejects, the exogenously given threat point is realized and payoffs are $M^S = p - 20$ and $M^B = 50 - p$.

Note that the bargaining game in NCT and the renegotiation game in CT have the same strategic structure and exactly the same monetary payoffs. The "markup" in NCT is just the difference between $\hat{p}$ and p, i.e. $m = \hat{p} - p$. If the seller does not change the exogenously given price p, the "markup" is zero.[9]

Furthermore, if the buyer rejected the seller's initial price offer at Stage 0 in CT or if Wednesday was the right day in a given round in CT, then the corresponding buyer and seller in NCT are assigned the respective payoffs of CT exogenously. They are informed that there is no trading opportunity in this round but that they get some exogenously given payoffs.

We conducted two sessions each of CT and NCT with 24 participants in the first session and 22 in the respective second session. We implemented three matching groups in each treatment.[10] Upon arrival in the lab, half of the subjects were randomly and anonymously assigned the role of a buyer, the other half the role of a seller. We thus have 23 buyers and 23 sellers in each treatment.

We also conducted two sessions of the Contract&Competition Treatment (CT&COMP) in which sellers competed at Stage 0 for making an initial offer to the seller and two corresponding sessions of the No Contract&Competition Treatment (NCT&COMP).[11] The treatments with competition are identical to the treatments without competition except for the fact that at the initial contracting stage two sellers compete for the right to make a contract offer to the buyer. The price is determined by an ascending clock auction. The starting price of the auction is zero. The price increases by one unit every second. The first seller to stop the clock wins the auction and makes a trade offer at the auction price to the buyer which the buyer can either accept or reject. The other seller gets a payoff of 0. Recall that in CT, a monopolistic seller can choose the price freely and make a take-it-or-leave-it offer to the buyer. In contrast, in CT&COMP, only the

[9] No uncertainty exists in treatment NCT and we therefore do not refer to different days of the week to illustrate the uncertainty and identify the "right day" for trading in the experimental instructions.
[10] In the first session of each treatment we had two matching groups with 12 buyers and 12 sellers. In the second session we had only 22 subjects and implemented only one matching group. With 24 rounds, subjects interacted with the same opponent more than once. However, subjects did not know when and with whom they would interact more than once. Thus, repeated game effects are unlikely.
[11] In each of these sessions we had 24 subjects and implemented two matching groups.

seller who wins the auction makes an offer and this offer is determined by the auction. In all other respects, CT and CT&COMP are identical. Finally, NCT&COMP is derived from CT&COMP in the same way as NCT is derived from CT. That is, in CT&COMP and NCT&COMP buyers and sellers face the identical strategic situations with the same monetary payoffs.

Sessions lasted between 1.5 and 2 hours and took place at the MELESSA laboratory of the University of Munich between June and September 2011. Each subject participated in one treatment only. Subjects were students of the University of Munich and the Technical University of Munich. The experiments were computerized with the software z-Tree (Fischbacher 2007). Payoffs were measured in experimental points that were exchanged into EUR at the end of the experiment. It is possible that subjects make losses in given rounds, e.g., when a buyer pays a price exceeding 50 but the good is delivered on the wrong day so that it is worth 50 only. Such losses were imposed and deducted from the earnings in other rounds. On average, subjects earned about EUR 25 (USD 32 at the time of the experiments), which includes a show-up fee of EUR 6. The experimental instructions for all treatments can be found in the supplementary materials, which can be accessed via the journals homepage.

4. Hypotheses

In this section we discuss several hypotheses that are implied by the different theories discussed in the introduction. The motivation of the hypotheses in the text is informal. In Appendix A we derive the hypotheses more rigorously.

We designed the experiments such that the strategic situation and the material payoffs of all players are exactly the same in the renegotiation game that is determined by the contracts in CT (CT&COMP) and the bargaining game that is set up exogenously in NCT (NCT&COMP, respectively). Thus, the traditional model of perfectly rational and selfish behavior (self-interest model) predicts the same (re-)negotiation outcome in all treatments. This is an immediate implication of the principle of subgame perfection.

> *Hypothesis 1 [Self-interest Model]:* The renegotiation outcome in the Contract Treatments with and without competition is the same as the bargaining outcome in the two No Contract Treatments: In all treatments the seller requests a markup of 49 or 50, claiming (almost) the entire renegotiation surplus for himself, which is accepted by the buyer in equilibrium.

The literature on social preferences argues that many people are not purely self-interested but also care about the welfare of other people. Models of altruism (Andreoni and Miller, 2002), inequity aversion (Fehr and Schmidt, 1999), or minmax preferences (Charness and Rabin, 2002) maintain the assumption that players are perfectly rational but allow for more general utility functions. They assume that the utility function of a player depends not only on his own material payoff but also on the material payoffs of other players. Since the strategic situation and the material payoffs of all players are the same in the Contract Treatments and the corresponding No Contract Treatments, these models also predict that there is no difference in behavior across corresponding treatments. However, the predicted behavior in the Competition Treatments differs from the predicted behavior in the No Competition Treatments. The reason is that fairness preferences predict that the bilateral renegotiation game will lead to a more equal distribution of the surplus, i.e., the seller will ask for a higher markup if competition lead to a low initial price and the buyer will accept a higher markup.

> *Hypothesis 2 [Outcome-based Social Preferences]:* The renegotiation outcome in the Contract Treatments is the same as the bargaining outcome in the corresponding No Contract Treatments. If subjects have outcome-based social preferences the seller will leave some of the surplus to the buyer. Furthermore, if the initial price is lower in the treatments with competition than in the treatments without competition, the seller will ask for a higher share of the renegotiation surplus when the ex ante contract was formed under competitive conditions. The buyer is willing to accept higher markups if the initial price is low (competition) than if the initial price is high (no competition).

Even though, from a standard game theoretic perspective, the renegotiation games in the Contract treatments are strategically identical to the negotiation games in the No Contract treatments, there is of course one crucial difference. In the Contract treatments the buyer and the seller interacted at a previous stage by agreeing to the initial contract. If the players have preferences that are not based on outcomes alone this difference may affect their renegotiation behavior. Some possible effects have been explored in the literature.[12]

[12] In addition to the effects of self-serving biases, loss aversion and social norms that we discuss below there are other possible effects that have not been explored in the literature so far. For example, the actions taken by the

Hart and Moore (2008) argue that contracts serve as reference points that may affect ex post behavior. Their paper focuses on the trade-off between flexibility and shading in at-will-contracts, while our experiment considers renegotiation of a specific performance contract. However, in Section VI of their paper, Hart and Moore (2008) discuss three different views on how their model can be applied to renegotiation. Their preferred, "intellectually more coherent" view takes the position that the price of the initial contract is such a strong reference point that it cannot be changed without an objective justification.[13] Thus, the seller will not charge a markup if his cost to deliver on the right day goes down or stays the same. He may charge a markup only if his cost increases and only if the markup is justifiable by the cost increase. As Hart and Moore point out, this view is consistent with legal practice and social custom. "The courts require that renegotiation must be in good faith, but, because this is difficult to monitor, they will often substitute the requirement that the renegotiation can be justified objectively; for example, the price increases because […] (the seller's) costs have risen" (2008, p. 31). Hart and Moore further argue that social attitudes and norms often mirror the law, so people will follow this norm even if there are no courts to enforce it. This point is also made by Iyer and Schoar (2013) who argue that even in the absence of a judicial system a social norm exists that prevents the seller from proposing a price increase.

> *Hypothesis 3 [Social Norms (Hart and Moore, 2008, Iyer and Schoar, 2013)]:* If there is an initial contract (in CT and CT&COMP) the seller will deliver on the right day without charging a markup if his cost to do so is less than or equal to his cost for delivery on the day specified in the initial contract. If his cost is higher for delivery on the right day he charges a markup that is constrained by the cost increase. Without an initial contract (in NCT and NCT&COMP) there are no such constraints and the seller will charge significantly higher markups.

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contracting partners at the initial contracting stage could signal information about their types or intentions giving rise to type-based reciprocity (Levine, 1988) or intention-based reciprocity (Rabin, 1993, Dufwenberg and Kirchsteiger, 2004) at the renegotiation stage. The effects of type-based and intention-based reciprocity could go in both directions. This is why we do not explore this here but leave it to future research.

[13] The two other views on renegotiation both give rise to the prediction that if renegotiation is initiated, then the initial contract is no longer seen as a reference point and each party feels that it is entitled to get the entire social surplus from renegotiation. This implies that there is no difference between the Contract Treatments and the corresponding No Contract Treatments. An intermediate view, which takes the position that the truth must be somewhere in between the two extreme predictions, would imply that the initial contract somewhat constraints the markups charged by the seller, more so if his costs go down. This would be a weaker version of Hypothesis 3.

In addition, Hart and Moore (2008) argue that the reference point effect is stronger if the initial contract has been agreed upon under competitive conditions. The reason is that competition "provides a relatively objective measure of what B and S bring to the relationship" (p. 12). Thus if there is ex ante competition the initial contract has a stronger impact than if there is no competition ex ante. The next proposition summarizes this prediction:

> *Hypothesis 4 [Reference Points and Competition (Hart and Moore, 2008)]:* The effect of the initial contract to constrain markups is stronger if it has been formed under competitive conditions. Thus, the difference in markups between CT and NCT is smaller than the differences in markups between CT&COMP and NCT&COMP. Furthermore, there is no difference in negotiation behavior between NCT and NCT&COMP.

Herweg and Schmidt (2013) offer a different theory of contracts as reference points that is directly applicable to our experimental design. They consider a situation where a buyer and a seller write a specific performance contract that may turn out to be inefficient after the state of the world is realized. Parties can renegotiate the initial contract, but they suffer from loss-aversion. Thus, when the seller offers to deliver on the right day at a higher price, the buyer compares this proposal to the initial contract.[14] The price increase is considered a loss, the change to the right day a gain. Because the buyer is loss averse, losses loom larger than equally sized gains. Hence, the buyer is more likely to reject high markups if there is an initial contract to which the markup is compared, than if there is no initial contract. Anticipating this behavior the sellers will ask for lower markups in the Contract Treatments than in the corresponding No Contract Treatments.

[14] Herweg and Schmidt (2013) assume that the initial contract defines the reference point. Alternatively one could follow Köszegi and Rabin (2006) and assume that parties form rational expectations about what is going to happen in the future and compare the renegotiation outcome to the full distribution of possible outcomes. This assumption complicates the analysis considerably, but in our experiment it has the same effect of making prices sticky. With 40% probability Wednesday is the right day in which case there is no renegotiation and no markup. With 60% probability Wednesday is not the right day and the contract will be adjusted. Thus, buyers suffer a loss when they compare the proposed markup to the situation in which no markup is requested. This makes them more reluctant to accept the markup. Anticipating this effect, sellers offer more moderate markups in CT than in NCT (where buyers are not aware that there was a 40% chance that they did not have to pay a markup, so they do not suffer from loss aversion). If there is no initial contract the parties may also have a reference point (e.g. their outside options). However, by discussing and agreeing to the contract, the contract looms very prominently on their minds and becomes a much stronger reference point than if there is no initial contract. See Herweg and Schmidt (2013, p. 19-20) for a more detailed discussion of these points.

Hence, the initial contract makes prices sticky.[15] This prediction is similar to the prediction of Hart and Moore (2008). There are two important differences however. First, in Herweg and Schmidt the seller will always request a strictly positive markup. In contrast, Hart and Moore predict that no markup is requested if the seller's cost to deliver on the right day is smaller than or equal to his cost to deliver on Wednesday and that the markup is bounded above by the cost increase otherwise. Second, in Herweg and Schmidt (2013) there is no effect of competition on (the strength of) the reference point.

> *Hypothesis 5 [Loss Aversion (Herweg and Schmidt, 2012)]:* The seller charges a lower markup if there is an initial contract than if no contract is in place. The markup is always strictly positive. It is independent of the cost of delivery if the costs are less than or equal to the cost on the day specified in the initial contract, and weakly increasing if there is a cost increase. It does however not matter for the requested markup whether the initial contract was formed under competitive or monopolistic conditions. Thus, the difference in markups between CT and NCT and between CT&COMP and NCT&COMP is the same. Furthermore, there is no difference in (re)negotiation behavior between CT and CT&COMP, nor between NCT and NCT&COMP.

5. Experimental Results

In this section we compare behavior in the renegotiation game starting at Stage 2 of the Contract Treatments (CT and CT&COMP) to bargaining behavior in the No Contract Treatments (NCT and NCT&COMP, respectively). Our experimental design ensures that the strategies available to both players and the material payoff functions are identical in the respective treatments. Recall that in the Contract Treatments renegotiation takes place if and only if (i) the seller's initial contract offer is accepted, (ii) the efficient day of delivery is not Wednesday, (iii) the buyer asks to change the day of delivery, and (iv) the seller does not insist to deliver on Wednesday. Thus, we first have to report the subjects' decisions prior to entering possible renegotiations at Stage 2. We start out with the treatments that have no competition at the initial contracting stage.

[15] The same effect obtains if the initial contract is seen as an "anchor" by the two parties. The difference between reference points and anchors is subtle (see e.g. Kahneman, 1992). A change of the reference point changes the preferences of a loss-averse decision maker. In contrast, an anchor is an exogenous factor that affects behavior without being an expression of preferences. However, in the setup of our experiment both models have the same implications. We are grateful to a referee for pointing this out.

5.1 Initial Prices, Acceptance Decisions, and Entering Renegotiations in CT

Sellers ask for a mean price of 64.3 at the initial contracting stage in CT. Note that if Wednesday is the right day, a price offer of 60 shares the surplus equally between the buyer and the seller. In fact, as shown in Figure 1, 60 is the mode of the price distribution at Stage 0. 88% of the initial contract offers (484 out of 552) are accepted. While initial price offers of less than 70 are almost always accepted (in 365 out of 370 cases), the rejection rate rises sharply for higher prices; price offers above 75 are always rejected.

In 60% of all cases Wednesday is not the right day and an efficiency gain can be realized by changing the day of delivery. There are very few cases in which the buyer did not ask for a change of the day of delivery or in which the seller insisted on trading on Wednesday. In these cases the initial contract was executed. Altogether we consider 276 cases in which the parties entered the renegotiation game. In the following, we compare these 276 observations of renegotiation behavior in CT to the corresponding 276 cases of bargaining behavior in NCT.[16]

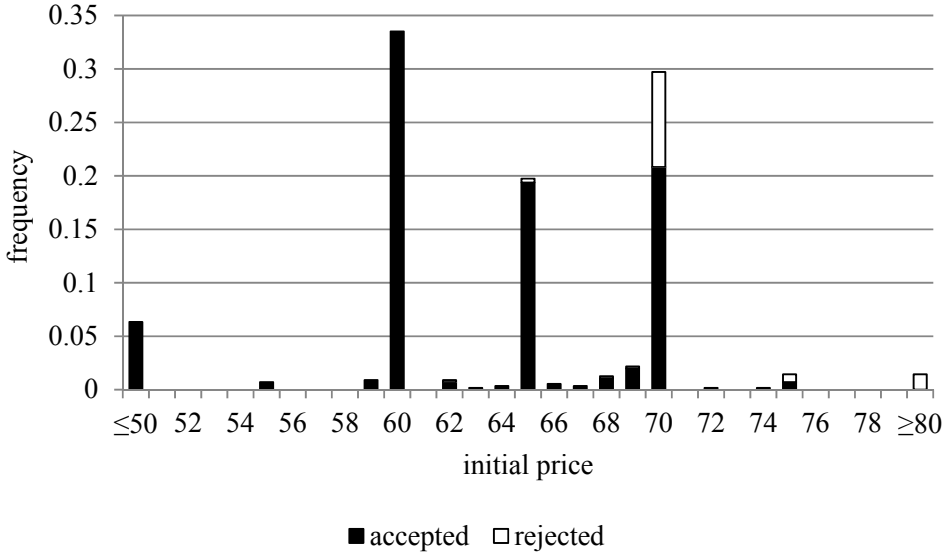

Figure 1: Distribution of initial price offers and acceptance decisions in CT.

[16] Out of the 484 initial contract offers that were accepted in CT, Wednesday turned out not to be the right day in 306 cases. In 4 of these cases, the buyer did not ask for delivery on the right day, and in 9 cases the seller simply delivered on Wednesday. There are also 17 cases in which the seller did not want to trade in NCT. We disregard the corresponding cases in CT to ensure that we consider the same number of observations with exactly the same threat points and trading opportunities in CT and NCT.

5.2 Markups with and without Ex-ante Contracts (CT vs. NCT)

In the renegotiation game of CT and in the bargaining game of NCT the seller can either make a (re)negotiation offer, i.e., offer to deliver the good if the buyer agrees to a markup, or he can deliver the good without asking for a price change, in which case the markup is zero. In the latter case no acceptance decision is required. Our main interest is whether sellers request different markups in CT than in NCT even though the strategies available to the players, the payoffs, and the threat points are exactly the same in both situations.

> ***Result 1 (The Effect of Contracts on Markups):*** *Markups in CT are significantly lower and less frequent than in NCT, in particular if the seller's cost for delivery does not increase.*

In the renegotiation game of CT sellers ask on average for a markup of 14.9, while the average markup in the negotiation game of NCT is 27.0. Thus, the ex ante contract causes sellers to reduce their markups by 44.8%. Since observations might not be independent within matching groups, we treat matching group averages as the unit of observation in the non-parametric tests throughout the paper. We find that all three matching group averages are lower in CT than in NCT. The difference in the means of the markup is significant at the 5% level (one-sided rank sum test, p=0.050).[17] Figure 2 plots the average markup in the matching groups, using the fact that we have paired matching groups (with identical treat points). The location of the data points above the 45-degree line shows that the average markup is higher in NCT than in CT in each pair. Figure 2 also shows the respective data for our Competition Treatments, which will be discussed in Section 5.3 below. The regression analysis reported in Table 1, which is explained in detail in Section 5.4, also confirms the significance of these differences.

Result 1 is further illustrated by Figure 3 showing the full distribution of markups in both treatments. For non-negative markups, the distribution of markups in NCT first-order stochastically dominates the distribution in CT.[18] Figure 3 also shows that the seller chooses to deliver the good on the right day without requesting any markup in 20.7% of all cases (57 out of 276) in CT. This happens almost exclusively when the seller's costs to deliver on the right day

[17] The application of a one-sided p-value is justified because we have a directed hypothesis for the comparison between CT and NCT.

[18] In NCT we have four observations with a negative markup while the lowest markup is zero in CT. A negative markup arises in NCT if the seller asks for a price $\hat{p}$ that is smaller than the exogenously given price p.

are smaller or equal to 20: The seller did not ask for a markup in 53 out of the 171 cases (31%) where the seller's cost was smaller or equal to 20, but he did so only in 4 out of the 105 cases were the cost exceeded 20 (4%). This result suggests that a significant fraction of sellers feel obliged to deliver the good at the terms of the initial contract if they can do so at no additional cost. In contrast, the seller delivers at the exogenously given price in only 9.1% of the cases (25 out of 276) in NCT. This difference is driven by much fewer instances of delivery without markup in rounds in which the seller's cost to deliver on the right day are smaller or equal to 20 (21 out of 171, i.e. 12% only). All three matching group averages of the fraction of zero markups are higher in CT than in NCT (one-sided rank sum test, p=0.050).[19]

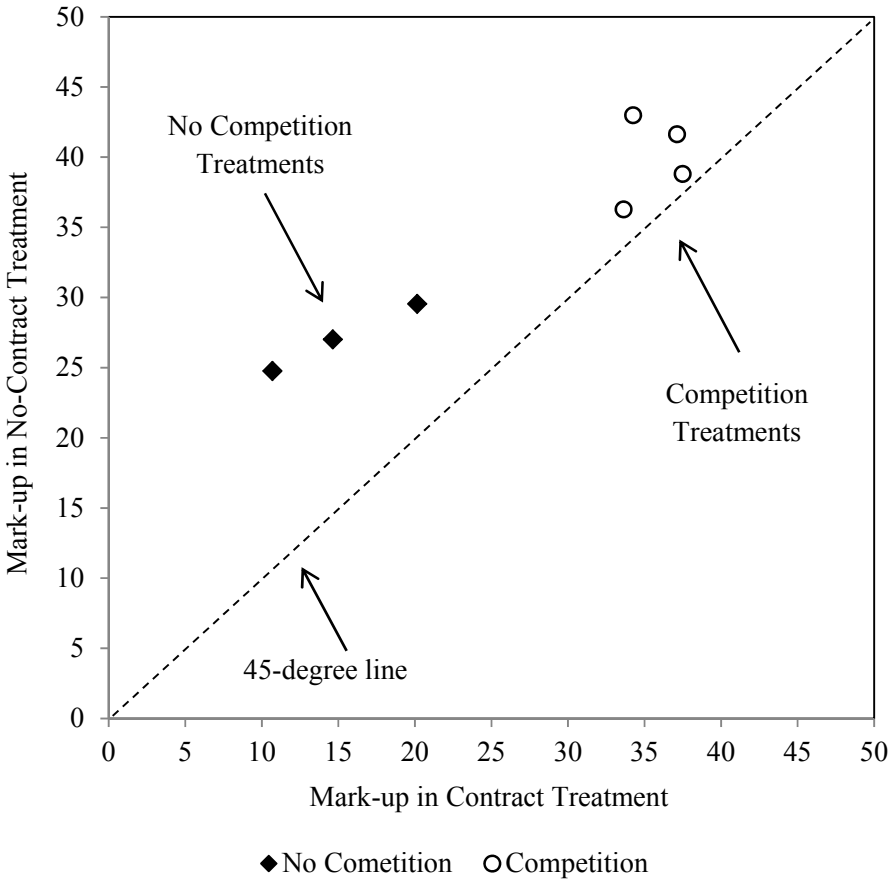

Figure 2: Mark-up averages in paired matching groups in CT and NCT

[19] Recall that the seller's cost realizations are by design exactly identical in CT and NCT and thus cannot drive the treatment difference.

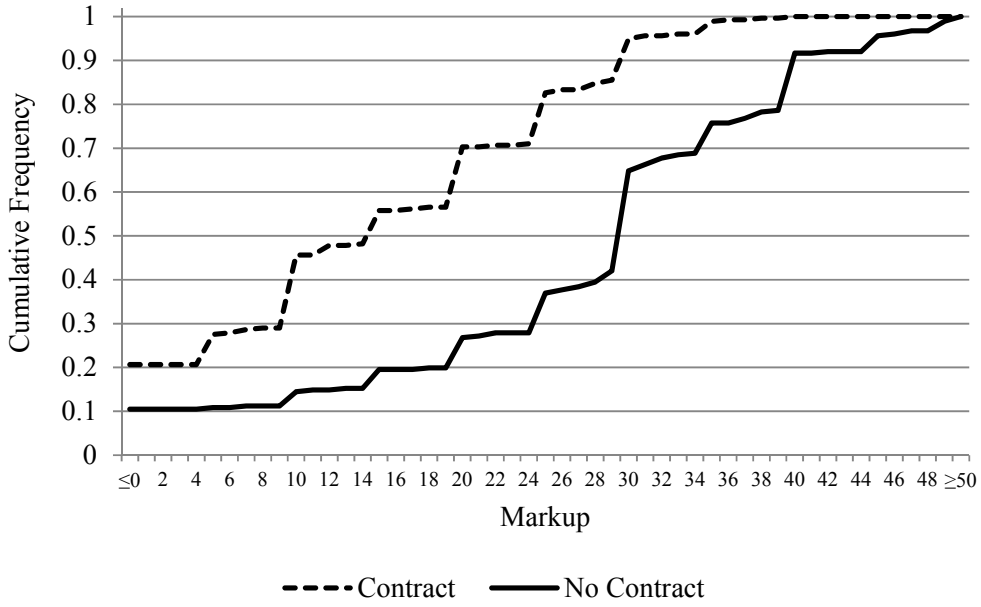

Figure 3: Cumulative frequency of markups in CT and NCT

A possible confounding factor of our experimental design is that buyers and sellers self-select into the bargaining situation in CT because they first have to agree upon the initial contract. This is unavoidable because mutual agreement is an essential characteristic of any contract. If the parties do not agree they do not reach the renegotiation stage, which happened in 12% of all cases. Thus, we may have less "aggressive" sellers and more "accommodating" buyers in the renegotiation game of CT as compared to the negotiation game in NCT, where sellers and buyers are randomly allocated to the bargaining situation. This may have two effects going in opposite directions. On the one hand, less aggressive sellers may make lower mark-up offers. On the other hand, more accommodating buyers may invite higher mark-ups. However, even if we ignore the second effect, the less aggressive offers in CT cannot possibly explain Result 1. In CT there are 12% rejections of initial contract offers, so that the 12% most aggressive offers (of the most "aggressive" sellers) might not be present in the renegotiation game. Even if we disregard the 12% highest markups in NCT, the average markup in NCT still amounts to 24.4, so the markup in CT is still 38.9% lower. A one-sided rank sum test on the level of matching group averages remains significant at the 5% level (all three matching group averages are still lower in CT than in NCT). Finally, in Section 5.3 below we consider treatments with competition between sellers at the initial offer stage. In these treatments we observe no rejections of initial contract offers, i.e. no sorting, but replicate the effect of contracts on markups.

We now turn to the buyers' acceptance decision of the (non-zero) markup offers. We find that at the (re)negotiation stage 92.2% of all offers are accepted in CT and 86.1% in NCT. A rank sum test on matching group averages shows that this difference is not significant (two-sided, p=0.200). While there is no significant difference of the overall rejection rates between the two treatments, there is a large and significant difference if we control for the size of the requested markup:

> ***Result 2 (The Effect of Contracts on Rejection Behavior):*** *For given requested markups buyers are significantly more likely to reject the offer in CT than in NCT. However, because sellers ask for much lower markups in CT the overall rejection rate is not significantly different in CT than in NCT.*

The first part of Result 2 is illustrated by Figure 4. In NCT, there are virtually no rejections of markups of 25 or less (1 out of 77 observations), while the average rejection rate for these markups is about 6% in CT (10 out of 171 observations). Also for higher markups, in the markup bins shown in the figure, the rejection rate is almost twice as high in CT than in NCT, with the exception of markups of 26-30. There are no observations of markups larger than 40 in CT.

Note that we have the same selection issue here as in Result 1. However, here selection should unambiguously work against our result. If the "more accommodating" buyers accepted the initial contract in CT, they should be more likely to accept any given markup than the randomly selected buyers in NCT. Result 2 shows that the opposite is the case in our experiment. Thus, if anything, Result 2 understates the effect of the initial contract on rejection behavior.

The regression analysis in Table 2, reported in detail in Section 5.4 below, confirms Result 2. The regressions show that for given markups an initial contract has a significant negative effect on the probability of acceptance. The size of the markup also has a highly significant negative effect. However, buyers are more willing to accept a higher markup the lower the price in the initial contract. The analysis of the buyers' acceptance behavior shows that buyers are more reluctant to accept high markups in CT than to accept the same markups in NCT, even though final payoffs and the threat points in case of bargaining breakdown are the same.

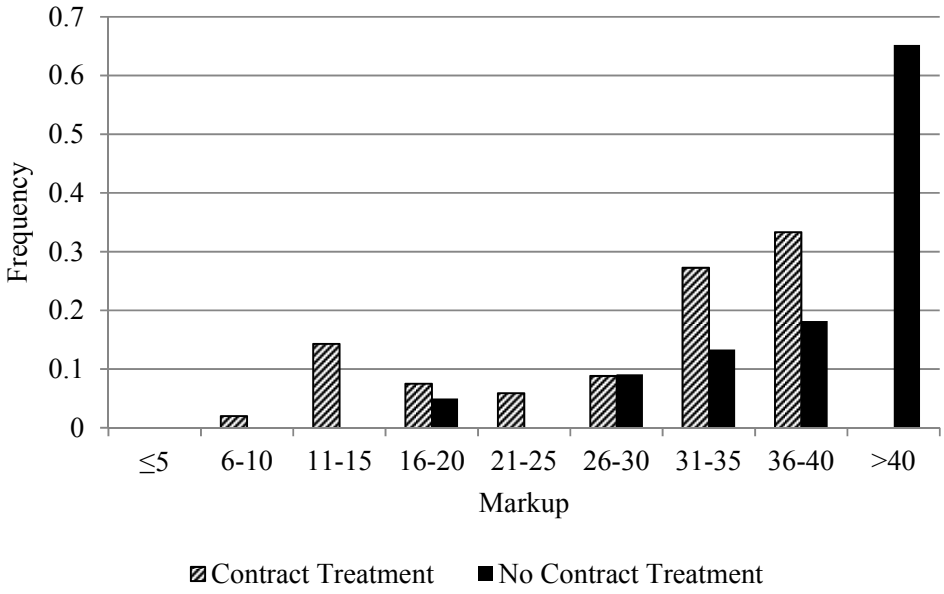

Figure 4: Rejection rates in CT and NCT for given markups.

To summarize, we find large and significant treatment effects on both the sellers and the buyers. Since the strategies available to both players and the monetary payoffs are identical in CT and NCT, these treatment effects cannot be due to the impact of the initial contract on the threat point. Instead, Result 1 shows that the mere fact that the parties had written an initial contract is causal for the much smaller increase in prices in renegotiations. The initial contract makes prices sticky. This rejects Hypotheses 1 (pure self-interest) and 2 (social preferences) but is consistent with Hypotheses 3 (social norms) and 5 (loss aversion). Moreover, we find that the presence of initial contracts causally affects the buyers' acceptance behavior. Result 2 shows that buyers are less willing to accept price increases on top of an initial contract than equally sized prices in the treatment without an initial contract, which is again consistent with Hypotheses 3 and 5, but not with Hypotheses 1 and 2. The finding that about 30% of the sellers are willing to deliver on the right day if this does not lead to higher costs, while only 4% do so if there is a cost increase, lends support to Hypothesis 3. However, it also shows that about 70% of sellers ask for positive markups even if their cost of delivery is not higher on the right day, which is rather in line with Hypothesis 5 predicting that sellers will always ask for a positive markup.

5.3 The Effects of Competition

In this section we address the claim of Hart and Moore (2008) that a contract that was written under competitive conditions provides a stronger reference point because it is a more objective measure of what a buyer and a seller brings to a trading relationship. If there is competition at the initial contracting stage, the initial contract therefore has a stronger impact on expectations and entitlements than if there is no competition. We test this hypothesis in the Contract and Competition Treatment (CT&COMP) and the No Contract and Competition Treatment (NCT&COMP).

We find that the mean initial price is 24.8 in CT&COMP, compared to 64.3 in CT. The much lower initial price reflects the strong competition between sellers at the initial stage. In CT&COMP all initial contract offers are accepted. Altogether we consider 222 cases in which the parties entered the renegotiation game.[20]

CT&COMP differs from CT in two respects: First, the initial price is determined by competition and not by a monopolistic seller. Second, initial prices are much lower with competition than without competition. NCT&COMP allows us to separate these two effects. NCT&COMP is derived from CT&COMP in the same way as NCT is derived from CT: There is no initial contract in NCT&COMP, but the buyer and the seller are exogenously assigned the same outside options as in CT&COMP.[21] Thus, when we compare behavior in these two treatments there is only the effect of the contract, but no effect of lower initial prices.

> ***Result 3 (The Effect of Contracts under Competition):*** *The average markup is significantly higher in NCT&COMP than in CT&COMP. However, the difference in markups between NCT&COMP and CT&COMP is smaller than the difference in markups between NCT and CT.*

[20] Even though we have the same number of sessions for the treatments with competition than without competition, we have fewer observations with competition because always two sellers are paired with one buyer. Moreover, if Wednesday is not the right day (240 out of 384 cases) there are 3 cases in which the buyer did not ask for a change of the day of delivery and 9 cases in which the seller insisted on trading on Wednesday so that the initial contract was executed. Also, 6 sellers decided not to trade in NCT&COMP. We again disregard the corresponding cases in CT&COMP to ensure the same number of observations with exactly the same threat points and the same cost realizations in our comparisons between CT&COMP and NCT&COMP.

[21] For each group of two sellers and one buyer in CT&COMP, the outcome of the auction and the price $\tilde{p}$ signed in the contract gives rise to a vector of outside options ($\underline{M_1^S} = \tilde{p} - 20$, $\underline{M_2^S} = 0$, $\underline{M^B} = 50 - \tilde{p}$), where seller 1 denotes the seller who was successful in the auction. In the corresponding group of two sellers and one buyer in NCT&COMP these outside options and the corresponding cost realization are assigned exogenously to the buyer and to seller 1, while seller 2 is informed that he cannot trade in this period and gets a payoff of zero.

The average markup is 40.0 in NCT&COMP, while it is only 35.6 in CT&COMP. Thus, the initial contract that was formed under competitive conditions causes sellers to offer markups that are 10.8% lower than the markups offered if there is no initial contract. A one-sided rank sum test on markup averages in matching groups yields p=0.057. Figure 2 in Section 5.2, using the fact that we have paired matching groups (with identical treat points), illustrates that the average markup is higher in each matching group in the No Contract Treatment than in the corresponding matching group in the Contract treatment. Figure 5, the equivalent to Figure 3 in Section 5.2, shows the cumulative distribution of all markups in CT&COMP and NCT&COMP. It is evident that there is again a clear shift in the distribution and that the non-negative markups in NCT&COMP (almost) first order stochastically dominate markups in CT&COMP.[22]

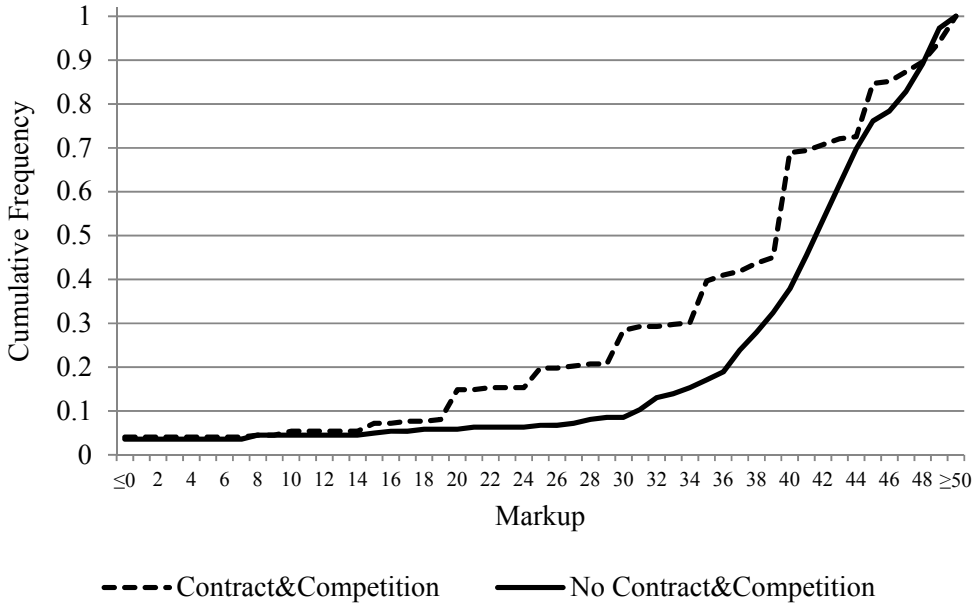

Figure 5: Cumulative frequency of markups in treatments CT&COMP and NCT&COMP.

Note, however, that the difference in prices between NCT&COMP and CT&COMP is smaller than the difference in price between NCT and CT. Thus, it seems that competition does not constrain the seller's markup more strongly with competition than without, which would not be in line with Hypothesis 4. We will get back to this point when we discuss the regression analysis in Table 1 below. Note that markups in CT&COMP are relatively high already such that

[22] We have a single observation of a negative markup in NCT&COMP while all markups in CT&COMP are weakly positive. The cumulative frequency of the non-negative markups in NCT&COMP lies below the one in CT&COMP except for the frequency at a markup of 49.

there is less "room" for markups in NCT&COMP to exceed markups in CT&COMP compared to the No Competition Treatments. Figure 5 however shows that even in NCT&COMP almost all markup offers are strictly below 50 and almost 40% of the offers do not exceed a markup of 40. Hence, higher markups would have been feasible in NCT&COMP. It is thus unlikely that "ceiling effects" are fully driving our result that the reference point effect of contract is not stronger under competition.

Let us now compare the markups charged in CT to the markups charged in CT&COMP. In both treatments there is an initial contract, but the initial prices are much higher in CT than in CT&COMP.

> ***Result 4 (The Effect of Initial Prices on Markups):*** *Initial prices are much lower in CT&COMP than in CT. Sellers try to compensate for the lower initial prices by charging higher markups. Furthermore, sellers almost never deliver on the right day without charging a markup in CT&COMP.*

Initial prices are on average 24.8 in CT&COMP compared to 64.3 in CT. The average markup in CT&COMP is 35.6, more than twice as high as the average markup of 14.9 in CT. This difference in markups is significant and economically important. The matching group averages in all four matching group averages in CT&COMP are higher than the three matching group averages in CT (one-sided rank sum test, p=0.029). The result shows that there is a cost to the buyer to having strong competition at the contracting stage and to leaving little of the surplus to the seller in the initial contract. The cost is that after the buyer is locked in with the seller (i.e., after Williamson's "fundamental transformation"), the seller will behave much more aggressively at the renegotiation stage if he was squeezed at the initial stage. Furthermore, in CT&COMP sellers deliver on the right day without charging a markup in only 4.1% of all cases (9 out of 222), compared to 20.7% of all cases in CT (57 out of 276). A rank-sum test on matching group averages shows that the difference in the fraction of zero markups between CT and CT&COMP is significant (one-sided, p=0.029).

To be sure, a monopolistic seller who got a large share of the surplus at the initial stage can also request a high markup in the renegotiation game. However, in our experiment sellers do not do this. If they got a good deal initially they charge modest mark-ups. They go for very high markups only if they got an unfavorable deal in the initial contract. These results suggest that competition per se does not strengthen the reference point. Rather, the specific form of

competition appears to matter. If, for example, the competitive outcome is considered unfair, the power of a contract to serve as a reference point will be weakened. This has important implications for contracting ex ante. If the buyer uses an auction or some other competitive mechanism in order to squeeze the seller's profit, then the seller will claim a larger share of the surplus in the subsequent renegotiation game. Thus, a significant fraction of the financial gain that buyers achieve through ex ante competition can be lost again in renegotiation.[23]

Let us finally turn to the buyers' acceptance decisions of the (non-zero) markup offers under competition. We find that at the (re)negotiation stage 85.4% of the offers are accepted in CT&COMP and 86.5% in NCT&COMP. A two-sided rank sum test on matching group averages shows that this difference is not significant (p=0.886). However, Figure 6 illustrates that for given markups the rejection rates are higher in CT&COMP than in NCT&COMP. Note that there is no observation for a markup >50 in CT&COMP. Thus, as in the No Competition Treatments, buyers are more reluctant to accept a given markup if there was an ex ante contract. This is also supported by the marginal effects logit regressions on the buyers' acceptance decisions reported in Table 2 in the next section.

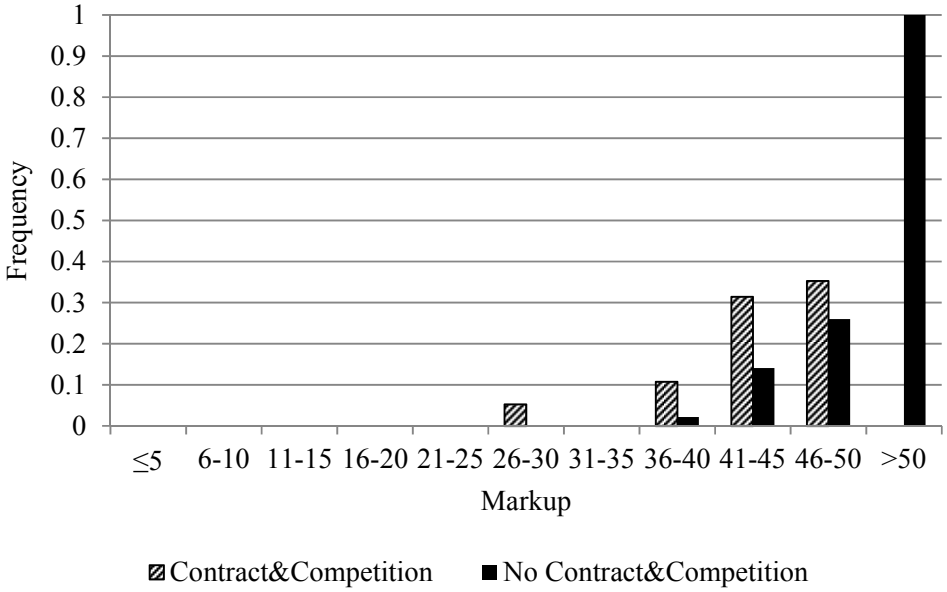

Figure 6: Rejection rates in CT&COMP and NCT&COMP for given markups.

[23] The average initial price of initially accepted contract offers is 63.2 in CT and 24.8 in CT&COMP. The average final price is 71.4 in CT (averaging over the cases where sellers could renegotiate and those where they could not), an increase of 13%. The average final price in CT&COMP is 42.2, an increase of 69.7%.

5.4 Regression Analyses

Table 1 reports regression analyses that support our results on what is driving the markups charged by the sellers. The dependent variable in all regressions is the absolute size of the markup in the four treatments. The No Contract Treatment serves as the baseline condition. "Contract" is a dummy variable taking on value 1 if an observation comes from one of the two treatments with an ex-ante contract (CT and CT&COMP). "Competition" is a dummy variable taking on value 1 if the observation comes from one of the two treatments with competition (CT&COMP and NCT&COMP). The variable "Price" denotes the initial price agreed upon in the ex ante contract. The variable "Cost" is the cost of the seller to deliver the good on the right day. "High-Cost" is the interaction of a dummy variable taking on value 1 if the cost on the right day is strictly greater than 20 with the variable "Cost." Since observations might not be independent within matching groups, we cluster on the level of matching groups in all regressions reported in this section.

Regression (1) is a random effects model with individual seller specific error terms. Regression (2) is the corresponding OLS model. Both models show that there is a large and highly significant difference in markups between the Contract Treatments and the No Contract Treatments. The coefficient on "Contract" shows that the markup is on average about 12 points lower in CT than in NCT. The difference is smaller in the Competition Treatments, which can be seen by the positive coefficient of the interaction dummy "Contract × Competition," but significant (an F-test on the sum of the coefficients of "Contract" and "Contract × Competition" yields $p=0.001$ and $p=0.010$ in regressions (1) and (2), respectively). The finding that markups are lower in the Contract Treatments than in the No Contract Treatments is consistent with the idea that contracts serve as reference points, i.e., with Hypotheses 3 and 5, but not with Hypothesis 1 of pure self-interest or Hypothesis 2 of outcome-based social preferences.

Both regressions further show that competition as such does not affect the size of the markups in our experiment. The coefficient on "Competition" is insignificant, showing that competition does not have an effect in the No Contract Treatments. An F-test on the sum of "Competition" and "Contract × Competition" further shows that is also true in the Contract Treatments ($p=0.831$ and $p=0.767$ in regressions (1) and (2), respectively). We saw that markups are on average higher in the Contract treatments, but this is explained by the lower initial prices: Regressions (1) and (2) both show that the initial price has a strong and highly significant effect. An increase of the initial price by one unit reduces the markup by about 0.45 units, a strong

indication for social preferences (Hypothesis 2). The regressions further show that the interaction of Contract and Competition has a (marginally) significant influence on markups. It goes, however, in the opposite direction as predicted by Hypothesis 4. This shows that competition is not a prerequisite for contractual reference points. Contracts that have been negotiated under non-competitive conditions may be equally strong in constraining behavior than contracts that have been formed under competition. The idea of "contracts as reference points" thus applies more generally than envisaged by Hart and Moore (2008).

Regressions (3) and (4) consider, in addition, the cost of delivery on the right day.[24] Both regressions show that the cost of delivery has a (marginally) significantly larger and positive effect on markups in the Contract Treatments than in the No Contract Treatments, where the cost has no significant effect. This is consistent with Hypotheses 3 and 5. Moreover, the random effects regression (3) suggests that markups are generally higher if there is a cost increase, which is indicated by the fact the variable "High-Cost" is significant. This effect is however not significant in the OLS regression (4). Finally, regressions (3) and (4) both show that "Cost" or "High-Cost" do not have a significantly different effect if initial contracts were concluded under competitive conditions. Table 2 reports marginal effects logit regressions on the buyers' acceptance decisions that support our observation that for given markups rejection rates are higher in the contract treatments. Regression (1) shows that the coefficient of "Contract" is negative and (marginally) significant with a marginal effect of about 8 percentage points. Not surprisingly the effect of "Markup" is negative and highly significant. "Price" also has a significant negative effect. Thus, a higher markup reduces the probability of acceptance, but buyers are more likely to accept a high markup if the initial price was low, i.e. if a high markup is "fair" because it compensates the seller for the low price that he received initially. Most importantly, however, "Competition" and "Contract × Competition" are not significant. Thus, competition on its own or in conjunction with an initial contract does not affect the buyers' acceptance decisions. Regression (2) allows for a non-linear effect of markups on acceptance decisions, which renders the effect of "Contract" significant at the 5% level. Regressions (3) and (4) control, in addition, for the effect of the cost of delivery on the right day, but none of these

[24] It can be seen that the sign, magnitude and significance of the explanatory variables that we considered in regressions (1) and (2) remain roughly the same. Only the F-test on the sum of the coefficients of "Contract" and "Contract × Competition" fails to reach a conventional level of significance in the OLS model, but it remains highly significant in the random effects model ($p=0.011$ and $p= 0.112$ in regressions (3) and (4), respectively). The F-tests on the sum of "Competition" and "Contract × Competition" remain insignificant in both regressions ($p=0.409$ and $p=0.465$ in regressions (3) and (4), respectively).

variables turns out to be significant. Moreover, all other coefficients remain largely unchanged. Only the size of the negative effect of "Contract" on the buyers' acceptance decisions increases to about 12 percentage points; the significance level remains constant. Again, our findings regarding the buyer's acceptance decisions are consistent with Hypotheses 3 and 5, but they do not confirm Hypothesis 4.

Table 1: Regression Analysis of Markups

	(1) Random effects	(2) OLS	(3) Random effects	(4) OLS
	markup	markup	markup	markup
Contract	-11.70***	-12.11**	-16.53***	-16.85***
	(0.000)	(0.012)	(0.000)	(0.002)
Competition	-4.35	-6.24	-3.47	-5.96
	(0.268)	(0.242)	(0.351)	(0.238)
Contract × Competition	5.47*	7.79**	8.12**	10.46*
	(0.066)	(0.022)	(0.042)	(0.078)
Price	-0.436***	-0.483**	-0.414***	-0.474***
	(0.000)	(0.012)	(0.000)	(0.004)
Cost	-	-	-0.054	-0.023
			(0.571)	(0.864)
Cost × Contract	-	-	0.243**	0.222*
			(0.015)	(0.090)
Cost × Contract × Competition	-	-	-0.140	-0.172
			(0.240)	(0.506)
High-Cost	-	-	0.134**	0.109
			(0.027)	(0.152)
High-Cost × Contract	-	-	0.017	0.044
			(0.784)	(0.494)
High-Cost × Contract × Competition	-	-	-0.000	0.046
			(0.995)	(0.626)
Constant	54.27***	57.78***	52.39***	56.42***
	(0.000)	(0.000)	(0.000)	(0.000)
Number of clusters	14	14	14	14
R-squared	0.404	0.407	0.441	0.443
Observations	996	996	996	996

Notes: Random effects and OLS regressions with markup as dependent variable. "Contract" is a dummy variable taking on value 1 if an observation comes from CT or CT&COMP. "Competition" is a dummy variable taking on value 1 if an observation comes from CT&COMP or NCT&COMP. NCT serves as omitted category. "Price" denotes the price in the initial contract. "Cost" denotes the seller's cost of delivery on the right day. "High-Cost" is the interaction of a dummy variable taking on value 1 if the cost on the right day is strictly greater than 20 with "Cost." P-values clustering on 14 matching groups are shown in parentheses. To account for the low number of clusters we apply a wild cluster bootstrap-t procedure (Cameron, Gelbach, and Miller 2008) to determine the p-values in the OLS regressions. ***, **, and * denote significance at the 1%, 5%, and 10% level, respectively.

Table 2: Regression Analysis of Buyers' Acceptance Decisions

	(1) logit marginal effects	(2) logit marginal effects	(3) logit marginal effects	(4) logit marginal effects
	accept	accept	accept	accept
Contract	-0.076*	-0.076**	-0.128**	-0.120**
	(0.057)	(0.047)	(0.044)	(0.033)
Competition	-0.073	-0.073	-0.057	-0.053
	(0.386)	(0.435)	(0.509)	(0.577)
Contract × Competition	0.036	0.033	0.034	0.020
	(0.349)	(0.434)	(0.445)	(0.719)
Price	-0.004**	-0.005**	-0.004**	-0.004**
	(0.017)	(0.015)	(0.044)	(0.043)
Markup	-0.010***	-0.003***	-0.010***	-0.003***
	(0.000)	(0.000)	(0.000)	(0.000)
$Markup^2$	-	-0.000***	-	-0.000***
		(0.000)		(0.000)
Cost	-	-	0.002	0.002
			(0.269)	(0.223)
Cost × Contract	-	-	0.000	-0.000
			(0.861)	(0.953)
Cost × Contract × Competition	-	-	0.002	0.003
			(0.216)	(0.148)
High-Cost	-	-	-0.001	-0.001
			(0.300)	(0.245)
High-Cost × Contract	-	-	0.002	0.003
			(0.291)	(0.237)
High-Cost × Contract × Competition	-	-	-0.003	-0.003
			(0.215)	(0.186)
Number of clusters	14	14	14	14
Observations	898	898	898	898

Notes: Marginal effects logit regressions with buyers' acceptance decisions as dependent variable. "Contract" is a dummy variable taking on value 1 if an observation comes from CT or CT&COMP. "Competition" is a dummy variable taking on value 1 if an observation comes from CT&COMP or NCT&COMP. NCT serves as omitted category. "Markup" ("$Markup^2$") denotes the markup offer (squared). "Price" denotes the price in the initial contract. "Cost" denotes the seller's cost of delivery on the right day. "High-Cost" is the interaction of a dummy variable taking on value 1 if the cost on the right day is strictly greater than 20 with "Cost." P-values clustering on 14 matching groups are shown in parentheses. ***, **, and * denote significance at the 1%, 5%, and 10% level, respectively.

6. Conclusions

Our experimental results demonstrate that a contract does more than just define the threat point of the renegotiation game. It also shapes and coordinates the expectations of the contracting partners about what is appropriate in contract renegotiation. This has a strong effect on renegotiation behavior. Thus, for the understanding of contract renegotiation it is not enough to look only at the threat point that is defined by the contract. The contract also serves as a reference point. This general insight is very much in line with the complementary work by Fehr, Hart and Zehnder (2009, 2011, 2014).

The purpose of our paper is to disentangle the different behavioral mechanisms that could be at work here. We find that sellers charge substantially lower markups in the renegotiation of an initial contract than in an otherwise identical bargaining situation in which no initial contract exists. Furthermore, buyers are more likely to reject high markups if there is an initial contract. This is consistent with the hypotheses by Hart and Moore (2008) and Herweg and Schmidt (2013) that a contract provides a reference point that shapes expectations and/or entitlements. As predicted by Hart and Moore (2008) and by a theory of internalized social norms (Iyer and Schoar, 2013) we find that there is a significant minority of sellers who are willing to adjust the good to the needs of the buyer without charging a markup, but only if the cost of doing so is less than or equal than the cost of delivering the specification that was agreed upon in the contract. On the other hand, this also shows that the majority of sellers ask for a positive markup even if the cost of delivery does not increase. Moreover, if there is competition (and the initial price is low), the markup is almost always strictly positive. These latter observations are more in line with Herweg and Schmidt (2013). Finally, our experimental results do not confirm the hypothesis of Hart and Moore (2008) that contracts that are written under competitive conditions are more powerful reference points in general. Even contracts that are written under monopolistic conditions have a strong reference point effect.

Furthermore, our results show that if the seller gets a low price in the initial contract (e.g. because of intense competition for the contract) the buyer benefits much less from this low price than the self-interest model predicts. The reason is that the seller will try to make up for the low initial price by charging a much higher markup in the renegotiation stage. The self-interest model always predicts a markup (almost) equal to the buyer's renegotiation surplus, but our data show that markups are lower when initial prices are higher. Buyers seem to accept this behavior

because overall rejection rates of markup offers are not higher under competition. These findings are consistent with the predictions of models of fairness and social preferences.

However, none of the theories alone is able to explain the observed behavior. Theories of contracts as reference points are required to explain the difference between the Contract and the No Contract Treatments. Models of social preferences are needed to account for the effect of initial prices on markups. Internalized social norms offer a good explanation for why some sellers do not charge a markup at all, but they cannot explain why we observe this behavior only if initial prices are high (in CT) and not when they are low (in CT&COMP). Thus, we need a combination of these different behavioral effects to fully understand the effect of contracts on renegotiation.

These results can be informative for the optimal design of contracts, organizations, and other governance structures. For example, if ex ante competition does not strengthen the power of the contract but rather induces sellers to behave more aggressively in the renegotiation game, then it is less valuable for buyers to induce ex ante competition. The question arises which forms of competition provide a generally accepted, objective measure of who brought what to the relationship? And which forms of competition are considered as being unfair, such that contracts give rise to less powerful reference points? Our results open up the door for many other intriguing questions. Are formal contracts more powerful than informal agreements? Do contracts on trade have a different effect than contracts on the allocation of ownership rights or the assignment of decision rights? Under what circumstances do initial contracts cause renegotiation to be more or less efficient? Answering these exciting questions is left to future research.

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Appendix

In this appendix we formally derive the theoretical predictions summarized in Hypotheses 1-5.

Hypothesis 1 is straightforward and follows directly from the assumption that all parties are interested only in maximizing their own material payoff and from the principle of backward induction.

Hypothesis 2: Suppose that players are concerned about fairness and have outcome-based social preferences as in Fehr and Schmidt (1999)

$$U_i(x_i, x_j) = x_i - \alpha \cdot \max\{x_j - x_i, 0\} - \beta \cdot \max\{x_i - x_j, 0\}$$

where x_i and x_j, $i, j \in \{B, S\}, i \neq j,$ are the monetary payoffs of the buyer (B) and the seller (S) and $\alpha(\beta)$ reflects how much the players suffer from inequality that is to their disadvantage (to their advantage, respectively) with $0 \leq \beta < \alpha$. Note first that there cannot be any difference between the Contract Treatments and the respective No Contract Treatments because the strategic structure and the monetary payoffs are identical. However, the (re-)negotiation outcomes between the treatments with and without competition can differ, because they give rise to different initial prices and thereby different income distributions.

We start at the last stage of the game where the buyer has to accept or reject the seller's markup offer. If the buyer rejects the offer, monetary payoffs are $x_B = 50 - p$ and $x_S = p - 20$, respectively. Note that in this case the seller has a higher monetary payoff than the buyer if and only if $p - 20 \geq 50 - p$, which is equivalent to $p \geq 35$. If the buyer accepts, monetary payoffs are $x_B = 100 - p - m$ and $x_S = p + m - c$, so the seller has a higher payoff then the buyer if and only if $p + m - c \geq 100 - p - m$, which is equivalent to $m \geq 50 - p + 0.5c$.

Consider the treatments without competition first. In these treatments the average initial price p was 64.3. In fact there was only one case (out of 552) in which a seller offered $p \leq 35$ and no case in which $p \leq 35$ and the parties entered renegotiations. Thus, if the buyer rejected the seller's markup offer, he would have always gotten a lower monetary payoff than the seller. It follows that if the seller offers the payoff equalizing markup $m = 50 - p + 0.5c$, then this

renegotiation offer would always be accepted by the buyer. If the seller charges a higher markup, the buyer would accept this markup iff

$$100-p-m-\alpha\cdot\left[2p+2m-100-c\right]\geq 50-p-\alpha\left[2p-70\right]$$

which is equivalent to

$$m\leq\frac{50+\alpha\left(30+c\right)}{1+2\alpha}=\overline{m}^{NoCOMP}$$

Consider now the treatments with competition. Here the average initial price p was only 24.8. In fact there were only 23 cases (out of 384) in which a seller offered a price $p>35$ and only 10 cases in which $p>35$ and the parties entered renegotiations. Thus, if the buyer rejected the seller's markup offer, he would have (almost) always gotten a higher monetary payoff than the seller. It follows that if the seller offers the payoff equalizing markup $m=50-p+0.5c$ and if $m\leq 50$, then this renegotiation offer would always be accepted by the buyer. (It happened only in 8 cases that the combination of the initial price and the cost on the right was such that the payoff equalizing markup would have been higher than 50. In these cases, the buyer trades off his lower monetary payoff and the reduced inequality, and would accept the offer iff $m\leq 50+\beta[70-2p]=\tilde{m}$.) If the seller charges a markup higher than the payoff equalizing markup, the buyer would accept iff

$$100-p-m-\alpha\cdot\left[2p+2m-100-c\right]\geq 50-p-\beta\left[70-2p\right]$$

which is equivalent to

$$m\leq\frac{50+\alpha\left(30+c\right)+(70-2p)(\alpha+\beta)}{1+2\alpha}=\overline{m}^{COMP}$$

A fair-minded seller with $\beta>0.5$ will choose a markup that equalizes payoffs (or $\tilde{m}$). Recall that this will always be accepted by the buyer. Note that because the initial price is much lower with competition than without, such a seller would request a higher markup if there is competition than if there was no competition ex ante. (Note that also $\tilde{m}$ is always higher than the payoff equalizing markup without competition.) A mainly self-interested seller with $\beta<0.5$ will choose the highest markup that he believes to be still be accepted by the buyer. Note that as long as $p\leq 35$ (which happened in more than 95% of all cases) the highest acceptable markup in the

Competition Treatments $\left(\overline{m}^{COMP}\right)$ is again higher than the highest acceptable markup in the No Competition Treatments $\left(\overline{m}^{NoCOMP}\right)$.

In the experiment sellers do not know the α and β parameters of their opponents. They may have had different beliefs about the distribution of these parameters and they may have differed in their degree of risk aversion. Both effects can give rise to a distribution of markup offers and some rejections of markup offers in equilibrium. However, since subjects are randomized to treatments, there should be no systematic difference in beliefs and risk aversion of sellers across treatments and we should expect that the distribution of markup offers is shifted to the right in the treatments with competition. Furthermore, the buyers' maximum acceptance levels should shift to the right by the same amount, so that there is no difference in actual rejection rates across treatments. Finally, the maximum acceptance levels of the buyers are increasing in the seller's cost in all treatments.

Hypothesis 3: Hart and Moore (2008) argue that the initial contract forms a reference point. They assume that parties have self-serving biases, i.e. each party feels entitled to get the maximum payoff that is feasible in a given situation. If a party gets less than what it feels entitled to it is aggrieved and shades in proportion to its aggrievement. There are no shading opportunities in our experiment, but the buyer can reject the contract. Thus, the more the buyer is aggrieved, the more likely it is that he will reject the contract.

Consider first the treatment without an initial contract. In this case the seller feels entitled to a markup of $m = 50$ and the buyer feels entitled to a markup of $m = c - 20$. The seller can make a take-it-or-leave-it offer, so he will propose a markup that maximizes the product of the markup and the probability that the markup is accepted. Note that the optimal markup is increasing in the seller's cost.

Consider now the Contract Treatments. Here the contract sets a strong reference point because both parties agreed to the price p. How is this reference point affected by renegotiation? Hart and Moore (p. 31) favor the view that any flexibility must be built into the initial contract. If this is not the case, there is no flexibility and the parties will stick to the initial price – in particular if the cost of the seller to produce on the right day is reduced:

> "…we believe that this position is consistent with legal practice and social custom. The courts regard contract renegotiations with some suspicion and may overturn them if they believe that opportunism or duress has played a role. (Social attitudes and norms often mirror the law.) To this end the courts require that renegotiation must be in `good faith,´ but, because this is difficult to monitor, they will often substitute the requirement that the renegotiation can be justified objectively; for example, the price increases because the seller is supplying an additional service and her costs have risen." (p. 31)

Thus, if the cost of the seller to produce the good on the right day is smaller or equal than his cost to produce on the initially specified day, the social norm will constrain the seller to deliver on the right day without charging a markup. If his costs are higher, he will offer to deliver on the right day and request a markup that can be justified by his cost increase. In the corresponding No Contract Treatments, no social norm ties the markup to the seller's cost and markups will thus be higher on average. However, Hart and Moore (2008, p. 30) also discuss two other possible views that both give rise to the following prediction in our experimental setup. According to these alternative views the possibility of renegotiation undermines the role of the contract as a reference point. In the extreme, as soon as the parties realize that the contract can be renegotiated, each party feels entitled to get the entire surplus from renegotiation – as in the No Contract Treatments. In Hypothesis 3 we take an intermediate position between these different views. The initial contract has some power to restrict the markups charged by the seller, in particular if his cost to produce on the right day is smaller or equal than 20, but for some subjects the power of the reference point may be reduced by renegotiation, so we predict to see some sellers requesting markups that are higher than their cost increase.

Hypothesis 4 considers the effect of competition. In CT&COMP, both parties agreed to the price p and - because the price is competitive - "it provides a relatively objective measure of what B and S bring to the relationship" (Hart and Moore, 2008, p. 12). Also in CT buyer and seller agree to a price p. The social norm to deviate from this price only when this can be justified by a cost increase will however be weaker because the contract is not concluded under competitive conditions. This implies that with competition the effect of the initial contract to constrain markups is stronger than without competition. Higher markups will thus be requested in

CT than in CT&COMP, so that the difference in markups between CT and NCT will be smaller than the difference between CT&COMP and NCT&COMP.

Hypothesis 5 builds on Herweg and Schmidt (2013). These authors also argue that the initial contract serves as a reference point, but the mechanism by which it affects the renegotiation outcome is based on loss aversion. When two parties write a long-term contract that has to be renegotiated after the realization of the state of the world, they take the initial contract as a reference point to which they compare gains and losses of the renegotiated transaction. Suppose that the buyer and the seller agreed ex ante to trade some specification the good (e.g. delivery on Wednesday) at price p. Then, after the realization of the state of the world they want to adjust the specification of the good (e.g. to delivery on the right day) and the price. However, the buyer feels a loss if the renegotiated price p is greater than the initially agreed payment $\bar{p}$. Similarly, the seller feels a loss if his cost to produce the new specification x is larger than his cost to produce the initially agreed specification $\bar{x}$. These losses loom larger than equally sized gains, e.g. the gain of the buyer to consume on the right day or the gain of the seller of receiving a larger payment. This drives a wedge between the value increase of the buyer and the cost increase of the seller which makes the renegotiation outcome sticky and potentially inefficient. In the context of our experiment the buyer will agree to the seller's renegotiation offer if and only if $100-p-m-\lambda^B \cdot m \geq 50-p$, where $\lambda > 0$ reflects the degree of loss aversion. This is equivalent to

$$m \leq \frac{50}{1+\lambda^B}.$$

Thus, the larger the degree of loss aversion, the smaller is the highest acceptable markup for the buyer.

The seller makes a take-it-or-leave-it offer to the buyer. He wants to choose the highest possible markup that is still accepted by the buyer subject to the constraint that he himself prefers this outcome to the outcome prescribed by the initial contract, i.e., if $p+m-c-\lambda^S \max\{c-20,0\} \geq p-20$. Thus, if $c \leq 20$ this constraint is always satisfied (for any markup $m \geq 0$). However, if $c > 20$ the seller is willing to agree to a renegotiation outcome only if $m \geq \left(1+\lambda^S\right)(c-20)$.

In the experiment the seller did not know the degree of loss aversion of the buyer and thus not the highest acceptable offer. If the seller is risk neutral he maximizes his expected payoff:

$$EU^S = \Pr\left(\lambda^B < \frac{50}{m} - 1\right)\left[p + m - c - \left(1 + \lambda^S\right)(c - 20)\right] + \left(1 - \Pr\left(\lambda^B < \frac{50}{m} - 1\right)\right)\left[p - 20\right]$$

subject to $m \geq \max\left\{\left(1 + \lambda^S\right)\left(c - 20\right), 0\right\}$. Let us assume that $\partial^2 \Pr\left(\lambda^B < (50/m) - 1\right) / \partial m^2 \leq 0$ which is a sufficient condition for the unconstrained maximization problem of the seller to have a unique solution m^* that is characterized by the first order condition

$$\Pr\left(\lambda^B < \frac{50}{m^*} - 1\right) = \frac{\partial \Pr\left(\lambda^B < \frac{50}{m^*} - 1\right)}{\partial m}\left[m^* - \left(2 + \lambda^S\right)(c - 20)\right].$$

By the implicit function theorem, the optimal markup m^* is an increasing function of c. Thus, the optimal markup of the seller is given by $\hat{m}(c) = \max\left\{m^*(c), \max\left\{(1 + \lambda^S)(c - 20), 0\right\}\right\}$ which is also weakly increasing in c.

Different sellers may choose different markups depending on their own degree of loss aversion λ^S, their degree of risk aversion, and their beliefs about the buyer's λ^B. These parameters are not observable in the experiment. However, an unambiguous prediction of the model is that the optimal markup is increasing in c, which is observable.