How Do Informal Agreements and Renegotiation Shape Contractual Reference Points?

Ernst Fehr, Oliver Hart, and Christian Zehnder*

October 2012

Abstract

Recent theoretical and empirical studies suggest that contractual reference points have important implications for economic transactions and organizations. However, previous studies ignore realistic aspects of trading relationships such as informal agreements and ex post renegotiation. We investigate the relevance of these features experimentally. Our evidence indicates that the central behavioral mechanism underlying contractual reference points is robust. However, our data reveal that contract renegotiation is a more nuanced process than the previous literature has recognized. We find, for example, that it is sometimes better for parties to write a simple (rigid) contract and then renegotiate ex post if needed, rather than to anticipate and include future contingencies in a (flexible) contract from the outset.

* Fehr: Department of Economics, University of Zurich, Blümlisalpstrasse 10, CH-8006 Zürich (e-mail: ernst.fehr@econ.uzh.ch); Hart: Department of Economics, Harvard University, Littauer Center 220, 1805 Cambridge Street, Cambridge, MA02138 (e-mail: ohart@harvard.edu); Zehnder: Faculty of Business and Economics, University of Lausanne, Quartier UNIL-Dorigny, Internef 612, CH-1015 Lausanne (e-mail: christian.zehnder@unil.ch). We gratefully acknowledge financial support from the U.S. National Science Foundation through the National Bureau for Economic Research and the Research Priority Program of the University of Zurich on the "Foundations of Human Social Behavior". We would like to thank Heski Bar-Isaac, Roland Benabou, Ryan Bubb, Sylvain Chassang, Bob Gibbons, Holger Herz, Louis Kaplow, Wolfgang Pesendorfer, Arno Riedl, Klaus Schmidt, Kathy Spier, Roberto Weber and Philipp Weinschenk for helpful comments.

I. Introduction

A series of recent papers develops the notion that ex ante contracts may serve as reference points for ex post trade (see Hart and Moore 2008, Hart 2009, Hart and Holmström 2010). The idea is that an initial contract circumscribes what parties feel entitled to later on and hence can reduce argument, aggrievement, and quality shading. The approach explains why parties may write a contract with rigidly fixed terms even though this leads to ex post inefficiency. In addition contractual reference points can explain employment contracts – which fix wages in advance and leave task discretion to the employer (Hart and Moore 2008); indexation in contracts and the role of payoff uncertainty for vertical integration (Hart 2009); and firm scope, authority and delegation (Hart and Holmström 2010). Initial evidence provides encouraging support for the new approach (Fehr, Hart, and Zehnder 2009; Fehr, Hart, and Zehnder 2011 (henceforth FHZ)), but previous studies neglect two key features of real-life trading relationships: informal agreements and ex post renegotiation.

Why are informal agreements potentially detrimental to the theory and implications of contractual reference points? The theory assumes that states are ex post observable but not verifiable, which means that the parties cannot rely (at least directly) on state-contingent contracts. However, ex post observability suggests that the trading parties could reach informal, state-contingent agreements. For example, they could agree on a formula that determines price as a function of cost. If the parties can use such informal agreements to "manage" expectations, they may be able to avoid the inefficiencies in flexible contracts caused by aggrievement and shading. In this sense informal agreements may destroy the trade-off between rigid and flexible contracts, because "managed" flexible contracts might achieve the first-best.

To see why ex post renegotiation may be important, suppose that a buyer and a seller agree on a rigid ex ante contract that fixes the price independently of the ex post realized cost of the seller. Assume that ex post trade is voluntary, and that the seller's cost is above the fixed price. Without renegotiation the seller walks away. With renegotiation, however, if the buyer's value is higher than the seller's realized cost, the parties can renegotiate their contract and enjoy the gains from trade. Thus, the possibility of ex post renegotiation raises questions about the cost of rigid contracts. More importantly, however, renegotiation challenges the ability of rigid contracts to serve as reference points that align the parties' expectations. Consider a state where the seller's cost is lower than the fixed price and trade is therefore feasible under the initial contract. Since the contract *can* be renegotiated the seller may feel

entitled to a renegotiation. If she does not get it, she may be aggrieved and shade. In other words the fact that renegotiation is always possible may imply that the contract ceases to be a reference point and the parties might regard the initial contract as putting no constraints at all on what is reasonable.

We design new experiments that examine informal agreements and renegotiation in a setting where a buyer and seller face ex ante uncertainty about whether the seller's cost is high or low (there are two states of the world). Ex post trade is voluntary. Ex ante the buyer can choose between a rigid contract specifying a single price and a flexible contract specifying a price range. (At this stage there is competition among sellers.) In the informal agreement condition buyers have the opportunity to communicate informally their pricing plans in flexible contracts i.e., they can make nonbinding state-contingent price announcements, which may align the trading parties' expectations and avoid ex post shading. Our data reveal that having this opportunity indeed reduces the shading rate in flexible contracts. As a consequence, flexible contracts become more attractive and buyers choose them more frequently than in the baseline condition where informal agreements and renegotiation opportunities do not exist. However, the decrease in shading is moderate and does not eliminate the trade-off between rigidity and flexibility. When informal agreements are available, low prices still trigger more shading in flexible contracts than in rigid ones. As a result, rigid contracts yield higher profits for buyers in the low-cost state than flexible contracts. This advantage is large enough to offset the disadvantage that rigid contracts do not allow for trade in the high-cost state. Even if informal agreements are available flexible contracts are, on average, no more profitable than rigid contracts. The result that informal agreements do not eliminate the trade-off between rigidity and flexibility is important, especially because the simplicity of our setup (only two possible states, completely symmetric information) gives informal agreements a very good chance to be effective.[2]

The lower shading rate in flexible contracts is driven not only by buyers who announce that they plan to pay low prices. Although low price announcements reduce the shading rate for a given final price relative to the baseline condition, about half of the buyers who choose a flexible contract do not make a price announcement. It turns out that flexible contracts without announcements are as good for buyers as contracts announcing low prices.

[2] Independently from us Brandts et al. (2012) investigate how communication affects the performance of rigid and flexible contracts. We discuss how our findings relate to theirs in Section IV.C.

Apparently, the sellers' perception of flexible contracts without a message depends on whether informal agreements are feasible or not: if a buyer does not attach a message although he could have done so, sellers seem to interpret this as an implicit message that the buyer has no intention to pay a high price. Therefore, low prices in flexible contracts without price announcements cause less shading than the same contracts in the baseline condition. This finding resonates with earlier evidence indicating that variations in the set of available but not chosen alternatives change perceptions of a given outcome (see, e.g., Charness and Rabin 2002, Falk et al. 2003). Our data suggest that these effects apply not only to variations in the payoff-relevant action space, but also to variations in non-binding communication opportunities.

Our data also reveal a second interesting effect of announcements. If buyers violate an informal agreement by choosing an ex post price which is lower than the ex ante announced price, the shading rate increases very strongly. This finding reinforces the interpretation that explicit price announcements of buyers have an impact on perceived entitlements of sellers.

In the condition with ex post renegotiation we allow the buyer unilaterally to replace the existing contract with a new one: since the seller has no veto, this is actually closer to what lawyers call a "repudiation". We deliberately chose this particular form of "renegotiation" because it provides a powerful stress test for the relevance of contractual reference points: the easier it is to change a contract the less likely it is to serve as a reference point. We find that renegotiation opportunities do not render contractual reference points irrelevant. Although renegotiation is always feasible, the parties do not seem to hope for outcomes outside the ex ante contract when trade is feasible within the contract. Specifically, if buyers in rigid contracts decide to stick to the agreed upon price in the low-cost state, the shading rate remains the same as in the baseline treatment. This is a strong finding. As contracts can be changed at no cost, the contract choice is ultimately a framing decision without consequences for feasible outcomes. Nevertheless, sellers seem to accept the competitively negotiated fixed price as a reference point and do not feel entitled to an upward renegotiation of the price. This makes it likely that contractual reference points also remain important when renegotiation is more difficult and/or costly.

Renegotiation improves rigid contracts if costs are high, because renegotiation allows the buyers to increase the price to cover the seller's cost. While these mutually beneficial renegotiations trigger some shading (probably because of misaligned entitlements caused by the newly introduced flexibility), the gains from trade are still substantial. Thus, buyers who

choose a rigid contract not only benefit from low prices and low shading rates in the low-cost state; renegotiation also allows them to realize the same profits as buyers with flexible contracts in the high-cost state. Therefore, in our renegotiation treatment, rigid contracts yield significantly higher profits than flexible contracts.

However, renegotiation is problematic to the extent that it leads buyers to breach the contract to lower the price and grab a larger share of the surplus. Such opportunistic renegotiations motivate many affected sellers to engage in substantial shading.[3] This finding is consistent with Hart (2009), who uses a similar view of renegotiation to explain the empirical finding that contracts exhibit a self-enforcing range: they are respected in "normal" states of the world but are breached in exceptional circumstances (see, e.g., Klein (1996)).

Interestingly, renegotiation opportunities also seem to change outcome perceptions in flexible contracts. As long as the buyer does not renegotiate, sellers are less likely to shade in response to a low price than in the baseline condition. While this behavior may be partly attributable to our assumption that buyers can unilaterally change the contract, it also reinforces the view that available but not chosen alternatives shape perceptions and behavior.

Perhaps the most important implication of our findings from the renegotiation treatment is that they provide support for a richer and more realistic view of the renegotiation process. In standard incomplete contracting models the parties can always do better by committing not to renegotiate. As any renegotiation process can be built into the initial contract, any further renegotiation simply adds incentive constraints (see, e.g., Maskin and Moore 1999). Thus we would expect in reality to see parties going out of their way to make ex post renegotiation difficult. Yet there is little evidence that parties deliberately put sand in the gears of the renegotiation process[4]. Our study helps to explain this. If the parties build the renegotiation process into the original contract—in our experiment this is equivalent to picking a flexible contract—then this raises the seller's feelings of entitlement in states where renegotiation is not needed (low-cost states) as well as in states where it is (high-cost states). The parties can do better by not incorporating renegotiation initially and then renegotiating ex post as needed.

---

[3] Bartling and Schmidt (2012) provide related experimental results (see Section IV.F for a discussion).

[4] For a contrary view, see Rajan (2012).

The remainder of the paper is organized as follows: In Section II, we describe the design of our experiment and provide details of procedures. Section III contains the behavioral predictions. We present and discuss our results in Section IV. Section V concludes.

II. Experimental Design

We present the market setup and the parameters in Section II.A. Section II.B describes the interaction of buyers and sellers. The details of the investigated experimental conditions are provided in Section II.C. We describe the laboratory procedures in Section II.D.

II.A. Market Setup and Parameters

Each experimental session has an equal number of buyers and sellers. In every period of the experiment buyers and sellers have the possibility to trade a product. Each seller can sell up to two units, while every buyer can buy at most one unit of the product per period. Hence the supply of the product is twice as large as the demand, and sellers face competition for buyers. When a buyer purchases a unit of the product from a seller, his payoff is equal to his valuation for the product v minus the price p. The payoff of the seller is defined as the difference between the price p and the production cost c. The buyer's valuation for the product depends only on the seller's ex post quality choice q. The seller's production cost, in contrast, also depends on the realized state of the world σ. There are two states of nature: a good state ($\sigma = g$), in which the seller's production costs are low, and a bad state ($\sigma = b$), in which the production costs are high. The good state occurs with probability $w^g = 0.8$.

The payoffs of buyers and sellers can be summarized as follows:

Buyer's payoff: $\pi_B = v(q) - p$.

Seller's payoff: $\pi_S = p - c(q, \sigma)$.

When trade occurs sellers can choose between two quality levels: normal quality ($q = q^n$) or low quality ($q = q^l$). The production costs for low quality are slightly higher than the production costs for normal quality: $c(q^l, \sigma) > c(q^n, \sigma)$. This reflects the idea that sellers can minimize costs if they simply provide the product desired by the buyer. However, they can sabotage output (at a small cost) if they want to.[5] For each unit of the product which a seller

[5] In Hart and Moore (2008), parties are assumed to be indifferent between shading (sabotaging) and not. We introduce costly sabotage to rule out equilibrium sabotage under standard economic assumptions. (We suppose

cannot sell – either because he did not manage to conclude a contract with a buyer or because his contract does not allow for a mutually beneficial trade – he realizes an outside option x_S = 10. When a buyer is unable to trade, he also realizes an outside option x_B = 10. Table 1 summarizes the cost and value parameters of the experiment:

In the experiment sellers and buyers interact in groups of four (two buyers and two sellers). To minimize the role of reputational considerations, these groups are randomly reconstituted at the beginning of each period. Thus, our protocol induces a series of one-shot interactions.

II.B. Interaction of Buyers and Sellers Within a Period of the Experiment in All Treatments

In the following we describe the different steps which characterize the interaction of buyers and sellers in *all* our treatments. Particularities of the different experimental condition are discussed in the next section:

Random formation of interaction groups:

At the beginning of every period a computerized random device defines the interaction groups consisting of two buyers and two sellers.

Phase 1: Ex ante contracting:

Step 1: Buyers' contract choice

Each transaction begins with the buyer's choice of a contract type (t). The buyer decides whether to offer a rigid contract ($t = r$) or a flexible contract ($t = f$). Rigid contracts define a single transaction price p^r ex ante. Flexible contracts, in contrast, specify a price range $[p^l, p^u]$ from which the buyer will choose the price ex post. The buyer can choose only the type of contract, but not the terms. The terms (i.e., the fixed price or the price range, respectively) are determined in a competitive auction among the sellers.

Step 2: Sellers' contract auction

After both buyers in an interaction group have chosen their type of contract, the two contracts are auctioned off to the sellers. The sequence of the auctions is randomly

---

that sabotage increases rather than decreases costs for reasons explained in FHZ.) The quality choice of the seller in our experiment is similar to costly punishment technologies that have been used in many other cooperation experiments (see, e.g., Fehr and Gaechter (2000) for a typical example). However, our experiment differs from typical gift exchange experiments (see, e.g., Fehr et al. (2009) for a review of this literature). In gift-exchange games the pecuniary incentive for workers (i.e., sellers) is to provide the minimal effort (i.e., quality) level, whereas in our paper the normal quality level maximizes seller earnings.

determined within each group. If a rigid contract is auctioned off the auction directly determines the fixed price $p^r \in [c(q^l,g) + x_S, 75] = [35, 75]$.[6] In a flexible contract the auction determines the lower bound of the price range $p^l \in [35, 75]$. The upper bound of the price range is exogenously fixed and equal to the buyer's valuation of the product when the seller provides normal quality: $p^u = v(q^h) = 140$. Thus, in both cases the auction starts off at 35 and then increases by one unit every half second. Each of the two sellers has a button that allows him to accept the contract at any time during the auction. The first seller who is willing to accept the displayed fixed price or the displayed lower bound respectively gets the contract. The seller who loses the auction and does not get the contract directly realizes the outside option x_S.

Determination of the state of the world:

After the contract auctions the computer randomly determines the state of the world for each contract independently. The state is common knowledge to the trading parties.

Phase 2: Ex post trading:

Step 3: Buyers' choice of contract terms

Once the state has been revealed, the buyer determines the final terms of the contract. How much flexibility he has in doing this depends on the experimental condition and the ex ante chosen contract. To initiate a mutually beneficial trade the buyer needs to be able to pick a price that covers the seller's cost. (It should be emphasized that trade occurs whenever price covers cost: a seller cannot refuse to trade if price covers cost although he can of course shade, i.e., choose low quality.) The flexible contract always allows for such a choice, but the fixed price contract does so only in the good state; in the bad state the fixed price of a rigid contract is lower than the seller's cost ($p^r \in [c(q^l,g) + x_S, 75] < c(q^n,g) = 80 < c(q^l,g) = 85$). In the latter case trade is feasible only if the buyer can renegotiate the contract (renegotiation is permitted in only one of our experimental conditions). If the buyer cannot or does not want to renegotiate the contract, trade does not occur and both trading parties realize their outside options. If the contract allows for trade

[6] The minimum of 35 for the fixed price ensures that the seller cannot make losses relative to his outside option in the good state even if he provides low quality. This feature guarantees that sellers do not refrain from choosing low quality, just because they want to avoid losses (loss aversion). The maximum of 75 for the fixed price ensures that the price is always below the seller's cost in the bad state of the world. This guarantees that trade is infeasible within rigid contracts if the bad state is realized. However, in the experiment the competitive forces in the auction were strong enough so that the maximum was never binding.

the buyer either pays the fixed price (rigid contract) or picks a price out of the available price range (flexible contract, or renegotiated contract).[7]

Step 4: The seller's quality choice

Sellers observe the price choice of their buyer and then determine their quality. The sellers always have the choice between normal (q^n) and low (q^l) quality. Remember that choosing low instead of normal quality increases the seller's cost by 5 units irrespective of the contract type and realized state of the world (see Table 1).

Payoffs and Market Information:

When all decisions have been made, profits are calculated and displayed on subjects' screens. In addition, to their profit information buyers also get some aggregated information about the market outcome.[8]

Subsequently. a new period begins and the participants are randomly reassigned to a new interaction group.

II.C. Experimental Treatments

We describe our two main treatment conditions. For completeness we also explain the baseline condition of FHZ, since we later use this condition as a benchmark for our results.

The Informal Agreement Condition (IA):

In the informal agreement condition buyers who choose a flexible contract in Step 1 can decide whether they want to combine the contract with a message of the following form:

> "If costs are low, I plan to pay a price of $p^A(g)$. If costs are high, I plan to pay a price of $p^A(b)$."

The price announcements are in no way binding for the buyer, i.e., the message does not affect the range of actual prices available to the buyer ex post.[9] The buyer can always pick

---

[7] In the bad state the buyer has to ensure that the price is such that the seller cannot make losses, i.e., he must choose a price $p \in [c(q_l,b) + x_S, v(q_h)] = [95, 140]$. Again we do not allow prices to be such that the seller can make losses by choosing low quality, since we want to avoid the possibility that people refrain from shading because of loss aversion (see also Footnote 6).

[8] The buyers are informed about average payoffs in rigid and flexible contracts of all buyers in all previous periods. In addition, they also learn how many buyers have chosen rigid and flexible contracts in the current period. The aim of the provision of this information is to make learning easier for buyers. Since our setup allows for many possible constellations (two contract types, two states of nature, two quality levels, many prices), learning from individual experience is rather difficult.

prices which are higher or lower than the announced price if the competitively determined price range of the contract allows this. All market participants are informed about the presence of the message opportunity in flexible contracts in the instructions of the experiment, i.e., the availability of messages is common knowledge in the experiment.

In the informal agreement condition renegotiation of contracts is not permitted. Accordingly, rigid contracts allow for trade only in the good state of the world. In the bad state trading parties with a rigid contract have to realize their outside option.

The Renegotiation Condition (RG):

In the renegotiation condition, there are no informal agreements. However, buyers always have the possibility to renegotiate the contract ex post (see Step 3 above). If a buyer decides to renegotiate the contract, the original contract is no longer of relevance and the buyer can choose any price that satisfies $p \in [c(q_l, \sigma) + x_s, 140]$. The seller cannot veto the buyer's decision to renegotiate the terms.[10] Renegotiation is available for rigid and flexible contracts in both states of the world, i.e., the buyer can always decide whether he wants to stick to the competitively concluded ex ante contract and accept the imposed restrictions (i.e., the fixed price in rigid contracts and the lower bound of the price range in flexible contracts, respectively) or whether he wants to abandon the contract and pick his price without restrictions.

It is useful to distinguish three types of renegotiation which may occur in this condition. First, the buyer may renegotiate a rigid contract in the bad state of the world. This allows for a price increase and makes trade feasible. As both parties benefit (at least weakly) from such a renegotiation, we call this a "mutually beneficial renegotiation". Second, the buyer may renegotiate a contract in the good state of the world in order to decrease the price to a level below the ex ante agreed upon fixed price or lower bound of the price range, respectively. We call this an "opportunistic renegotiation", because the buyer intends to increase his own profit at the expense of the seller. Finally, there is also the possibility that a buyer voluntarily increases the fixed price of a rigid contract in the good state of the world. We call these costly attempts to increase the seller's profit "altruistic renegotiations".

---

[9] This also implies that the buyer cannot stick to his price announcement if the announcement turns out to be below the lower bound of the price range determined in the auction. We explain this in detail to the participants in the instructions.

[10] We discuss this feature of the experiment in detail in section IV.F.

The Baseline Condition of FHZ (BL)

In the baseline condition of FHZ neither informal agreements nor renegotiation are available.

II.D. Subjects, Payments and Procedures

All subjects were students of the University of Zurich or the Swiss Federal Institute of Technology Zurich (ETH). Economists and psychologists were excluded from the subject pool. We used the recruitment system ORSEE (Greiner 2004). Each subject participated in only one session. Subjects were randomly subdivided into two groups (buyers and sellers) before the start of the experiment. The subjects' roles remained fixed for the whole session. All interactions of participants were completely anonymous.

To make sure that subjects fully understood the payoff consequences of the available actions, each subject had to read a detailed set of instructions before the session started. Participants then had to answer several questions about the feasible actions and the payoff consequences of different actions. We started a session only after all subjects had correctly answered all questions. The exchange rate between experimental currency units ("points") and real money was 15 Points = 1 Swiss Franc (~US $ 1, in November and December 2010).

In order to make the sellers familiar with the auction procedure we implemented two trial auctions – one with a rigid contract and one with a flexible contract – before we started the actual experiment. In the trial phase each seller had his own auction, i.e., they did not compete with another seller and no money could be earned.

The experiment was programmed and conducted with z-Tree (Fischbacher 2007). We conducted 5 sessions of the informal agreement condition, and 5 sessions of the renegotiation condition. We had 28 subjects (14 buyers and 14 sellers) in 5 of our 10 sessions and – owing to no-shows – 24 subjects (12 buyers and 12 sellers) in 4 sessions, and 20 subjects (10 buyers and 10 sellers) in 1 session. This yields a total number of 256 participants in the experiment. A session lasted approximately two hours and subjects earned on average about 50 Swiss Francs (including a show-up fee of 10 Swiss Francs).

III. Behavioral Predictions

In this section we derive a set of hypotheses for our experiment. In section III.A we present the predictions that result from the assumption that people are purely self-interested money-maximizers. While we do not believe that the self-interest hypothesis is an accurate

description of our participants' behavior, we still feel that these predictions are a useful benchmark, not least because much of the theoretical literature on incomplete contracts is based on models that assume pure self-interest. In section III.B we discuss how the presence of contractual reference points affects the predictions for our experiment.

III.A. Predictions under Pure Self-Interest

The prediction of the self-interest model is straightforward. Buyers anticipate that selfish sellers are never willing to engage in costly shading and therefore offer the lowest price permitted by the contract. Competition in the contract auctions implies that the fixed price in rigid contracts and the lower bound in flexible contracts are at the competitive level, i.e. $p^r = 35$ and $p^l = 35$.[11] This implies that rigid and flexible contracts yield the same profit for buyers in the good state of the world ($\pi_B = v(q^n) - p = 140 - 35 = 105$). In the bad state payoffs depend on whether renegotiation is available. If the buyer can renegotiate the contract, both contracts yield the same profit for the buyer ($\pi_B = v(q^n) - p = 140 - 95 = 45$) and the buyer is indifferent between the two. If renegotiation is not possible, the rigid contract results in the outside option ($\pi_B = x_B = 10$) and therefore the buyer strictly prefers the flexible contract. Whether or not informal agreements are available does not affect the predictions.

III.B. Predictions if Contracts are Reference Points

In this section we discuss how the Hart-Moore notion that competitively negotiated ex ante contracts provide reference points for ex post trade affects the predictions for each of our experimental conditions. For the baseline treatment of FHZ contractual reference points have the following implications: While contractual reference points do not affect the prediction that the contract auctions yield competitive outcomes ($p^r = p^l = 35$), they change the consequences of the buyers' contract choice. Of particular importance is the fact that flexible contracts may induce sellers to hope for high prices.[12] If a buyer picks a price which is below the seller's reference price, the seller may be aggrieved and engage in shading. As sellers may have

---

[11] Remember: Since $p = 35$ corresponds to $p = c(q^l,g) + x_S$ and the seller must offer at least $p = c(q^l,b) + x_S = 95$ in the bad state of the world, a seller can never be worse off if he accepts a contract than if he accepts his outside option.

[12] Hart and Moore (2008) assume that each party compares the ex post outcome to the most favorable outcome permitted by the contract. In FHZ we extend the model to allow for the case where parties may have heterogeneous reference points, i.e., we take into account that some traders may feel entitled to an outcome other than the most favorable outcome. We show that the predictions of such an extended model remain very similar to those of the original model.

heterogeneous reference points the frequency of shading is predicted to be decreasing in price. Thus, depending on the distribution of sellers' reference prices it can be optimal for the buyer either to avoid shading by increasing the price to a level above the lower bound of the price range or to accept the risk of getting low quality. Rigid contracts should avoid the shading problem, because they pin down the price from the outset and thereby fix expectations. If the shading problem in flexible contracts is severe enough, rigid contracts may be more profitable for buyers, even though they prevent the parties from trading in the bad state of the world.

In the informal agreement condition the central question is whether and to what extent the possibility to make ex ante price announcements allows buyers to "manage" sellers' reference points. If price announcements give buyers some control over sellers' reference points, buyers should try to push down reference points by announcing the lowest prices possible. Specifically, we would expects buyers to announce the competitive price for the good state ($p^A(g) = 35$) and the lowest feasible price for the bad state ($p^A(b) = 95$). As a consequence, seller may feel less entitled to high prices and therefore low prices should trigger less shading in flexible contracts as compared to the baseline condition.

In the extreme, informal agreements give buyers full control over seller's reference points, i.e., the seller never feel entitled to prices beyond those announced by the buyer. In this case, buyers would always choose flexible contracts with low price announcements, because such contracts would not only allow them to implement the first best (i.e., shading-free trade in both states), but they would also be able to reap (almost) all the available gains from trade.[13] More realistically, however, informal agreements will give buyers only limited control over sellers' reference prices. The buyer's optimal contract choice will then depend on the base level of shading in flexible contracts and the extent to which informal agreements reduce this shading rate. The larger the impact of low price announcements on sellers' reference points, the more attractive are flexible contracts for buyers.

The renegotiation treatment addresses two important questions regarding contractual reference points. The first one is: do contracts remain reference points even when renegotiation is feasible? And the second question is: how is the reference point determined once renegotiation has been initiated? The first question is of great interest for the cases where the parties decide to stick to the ex ante agreed upon contract. Basically, there are two

[13] As our design ensures that sellers cannot make losses even if they engage in costly shading, a small part of the surplus (5 points) would still go to sellers in this equilibrium (see Footnotes 6 and 7 for more details).

interesting possibilities. One possibility is that the parties continue to hope for their preferred outcome within the limits of the contract, i.e., the contract remains the reference point even though renegotiation would have been possible. The argument for this possibility would be that sellers explicitly agree to the contract in the competitive bargaining process which turns the contract into a focal point that defines their expectations. The alternative view would be that contracts completely lose their meaning in the presence of renegotiation opportunities and parties simply hope for their preferred outcome within the set of all feasible outcomes (including ones that can be reached only if the contract is renegotiated). This would imply that the reference prices are independent of both the contract type and the renegotiation decision, so that the buyer's contract choice would no longer make any difference for ex post performance. Which of these two views is realistic can be determined only from the data.

Obviously, the second question, i.e., the definition of reference points after the initiation of renegotiation, is important only if contracts continue to shape reference points when renegotiation is not initiated (otherwise the parties just hope for their globally preferred outcome, which is independent of the contract choice and the renegotiation decision). One possible view is that renegotiation simply turns the existing contract (be it a flexible or a rigid contract) into a completely flexible contract with price range $p \in [c(q_l,g) + x_s,\ v(q^n)]$. We think that this view is a plausible one when it comes to mutually beneficial or altruistic renegotiation. In our setup mutually beneficial renegotiation occurs when the buyer renegotiates a rigid contract in order to be able to increase the price in the bad state of the world. In this case the situation is indeed very similar to that in a flexible contract: both renegotiated rigid contracts and flexible contracts allow for the same price choices and there is no obvious reason why the seller should respond differently in the two situations. The situation is similar if the buyer decides to initiate an altruistic renegotiation (i.e., the buyer renegotiates a rigid contract in the good state of the world and increases the price to a level above the ex ante agreed upon fixed price).[14] However, we do not think that this view is accurate when it comes to opportunistic renegotiation. In our experiment opportunistic renegotiation can occur in two situations: i) if a buyer renegotiates a rigid contract in the good state of the world and picks a price below the competitively determined fixed price, and ii) if

[14] One might argue that altruistic renegotiations should always be perceived as generous, because the buyer renegotiates the contract and increases the price although this lowers his own payoff. However, if the sellers' aggrievement level is shaped by a self-serving bias, the sellers may still be disappointed if the buyer does not increase the price as much as they would have liked.

a buyer renegotiates a flexible contract in the good state of the world and picks a price below the competitively determined lower bound of the price range.[15] Since the buyer intentionally lowers the seller's profit, opportunistic renegotiation itself may be an important source of aggrievement on the seller side. If the sellers see opportunistic renegotiation of the contract as a hostile act, it is likely that the same deviation from their reference point produces much more aggrievement and shading than in a comparable situation in a flexible contract.

IV. Results

In this part of the paper we present and discuss the results of our experiments. We first discuss the informal agreement treatment and then move on to the renegotiation treatment.

IV.A. Informal Agreements: Comparison of Rigid and Flexible Contracts

We first investigate how the availability of informal agreements affects contract performance. The left-hand side of Table 2 summarize the results for rigid and flexible contracts. The table indicates average prices, relative frequencies of shading, auction outcomes, and profits of buyers and sellers. On average, auction outcomes are slightly above the predicted competitive level of 35 in both types of contracts (Rigid: 39.8 / Flexible: 38.7). However, a more detailed analysis reveals that prices actually converge to the competitive level over time. While the first 5 periods yield average auction outcomes of 44.1 (rigid contracts) and 44.4 (flexible contracts), the corresponding values in the final 5 periods are 36.4 (rigid contracts) and 35.1 (flexible contracts). Both negative time trends are statistically significant, but there is no significant difference between auction outcomes across contract types.[16] This implies that the price range in flexible contracts would have allowed buyers to choose the same prices as in rigid contracts in the good state of the world. Thus, if buyers successfully use informal agreements to manage sellers' reference points, prices and shading rates should be identical across contracts in the good state. This is not what we observe: on average, buyers in flexible

[15] It is important to mention that neither of these situations can occur in competitive equilibrium. If the fixed price or the lower bound of the price range is at the competitive level, the buyer cannot lower the price after renegotiation. However, since we expect that auction outcomes will often deviate from the competitive level (although they usually converge to the competitive level over time, see FHZ for details on the baseline condition), it is useful to consider these situations anyway.

[16] OLS regressions of auction outcomes on period reveal significantly negative time trends for both types of contracts (p-value < 0.01, standard errors clustered at the session level). An OLS regression of auction outcomes on a dummy for flexible contracts yields no significant effect (p-value = 0.276, standard errors clustered at the session level). A non-parametric signed-rank test with session averages as observations yields the same result (p-value = 0.312, two-sided).

contracts pay substantially higher prices (47.8) than buyers in rigid contracts (39.8). Column (1) of Table 3 investigates the statistical significance of this result. We regress prices in the good state of the world on an indicator variable which is unity if the buyer has picked a flexible contract. The regression reveals that the price in flexible contracts is significantly higher (p-value = 0.037, OLS estimation, standard errors clustered at the session level).[17] Table 2 shows that the higher prices in the flexible contract are not sufficient to prevent the sellers from engaging in shading activities. While the shading rate is only about 5 percent in rigid contracts, it amounts to 13 percent in flexible contracts. Columns (2) and (3) of Table 3 reveal that this difference is significant irrespective of whether we control for prices or not (p-value < 0.001 in both columns, Probit estimation (marginal effects reported), standard errors clustered at the session level).[18] The estimation in column (3) also reveals that higher prices reduce the shading rate significantly (p = 0.033). Additional estimations in which we regress the shading dummy on prices for each contract type separately (not included in the table) reveal that this effect is entirely driven by flexible contracts (p-value = 0.072). In rigid contracts prices do not significantly affect the quality choice of sellers (p-value = 0.237).

The lower prices and shading rates in rigid contracts have a positive impact on buyer profits in the good state. While buyers who have chosen a rigid contract realize an average payoff of about 98, buyers with flexible contracts get, on average, only about 87 (see Table 2). Column (4) of Table 3 confirms that this difference is significant (p-value = 0.027, OLS estimation, standard errors adjusted for clustering at the session level).[19] As rigid contracts do not allow for trade when the seller's costs are high, the higher profits of buyers with rigid contracts in the good state are obviously counterbalanced by lower profits in the bad state. Although flexible contracts also exhibit a considerable shading rate in the bad state (sellers engage in shading in 21 percent of the cases), trade is still much more attractive (average buyer profit = 33.9) than the low outside option in case of no trade (outside option = 10). However, the difference in buyer profits in the good state of the world is large enough to offset the disadvantage that rigid contracts do not allow for trade in the bad state: overall buyer profits are slightly higher in rigid contracts (78.2) than in flexible contracts (76.9) (see Table 2), but the difference is not significant (p-value = 0.759, see column (5) of Table 3).[20]

[17] A non-parametric signed-rank test with session averages as observations yields p-value = 0.031 (one-sided).
[18] A non-parametric signed-rank test with session averages as observations yields p-value = 0.031 (one-sided).
[19] A non-parametric signed-rank test with session averages as observations yields p-value = 0.031 (one-sided).
[20] A non-parametric signed-rank test with session averages as observations yields p-value = 0.313 (one-sided).

These results demonstrate that the trade-off between contractual flexibility and rigidity remains even if state-contingent, informal price announcements are feasible.

Next we compare our informal agreement treatment (IA) to the baseline condition (BL) in FHZ (see the right-hand side of Table 2). Remember the only difference between these two setups is that buyers in the informal agreement treatment have access to state-contingent price announcements in flexible contracts. With regard to rigid contracts the table shows that outcomes remain virtually unaffected by the availability of informal state-contingent contracts. In the good state average prices (IA: 39.8 / BL: 40.7) and shading rates (IA: 0.05 / BL: 0.06) are very similar and not statistically different from each other.[21] In the bad state trade remains infeasible in both treatments. As prices and shading frequencies are not affected, there are also no substantial differences in market participants' profits. Overall, buyers succeed in making average profits of 78.2 (IA) and 77.9 (BL), while sellers end up with average profits of 17.4 (IA) and 18.1 (BL). Neither difference is significant.[22]

The comparison of flexible contracts, in contrast, shows that the availability of informal agreements is not without consequence. While price levels are not (or are at most marginally) significantly different across treatments in both states of the world (Good state: IA: 47.8, BL: 51.1 / Bad state: IA: 97.9, BL 98.4)[23], shading rates in flexible contracts decrease when buyers have the possibility to combine flexible contracts with non-binding state-contingent price announcements (Good state: IA: 0.12, BL: 0.25 / Bad state: IA: 0.21, BL 0.30). Only the effect in the good state is significant.[24] As a consequence of the lower shading frequencies, flexible contracts yield higher buyer profits in the informal agreement treatment than in the baseline treatment in both states of the world (Good state: IA: 87.3, BL:

[21] Regressions of price and shading on a treatment dummy for the baseline condition yield insignificant effects (Price: p-value = 0.409 (OLS) / Shading: p-value = 0.574 (Probit), standard errors adjusted for clustering at the session level in both regressions). Non-parametric rank-sum tests with session averages as observations yield p-value = 0.421 (prices, two-sided) and p-value = 0.548 (shading, two-sided). In both treatments prices in rigid contracts converge to the competitive level over time. OLS regressions of price on period reveal significantly negative time trends in both treatments (p-value < 0.01). In the final period average prices are equal to 36.5 (IA) and 36.0 (BL), respectively. The shading rates, in contrast, do not exhibit significant time trends.

[22] Buyers: p-value = 0.887 / Sellers: p-value = 0.381, OLS estimations, standard errors adjusted for clustering at the session level. Non-parametric rank-sum tests with session averages as observations yield p-value = 0.421 (buyers, two-sided) and p-value = 0.421 (sellers, two-sided).

[23] Good state: p-value = 0.196 / Bad state: p-value = 0.610, OLS estimations, standard errors adjusted for clustering at the session level. Non-parametric rank-sum tests with session averages as observations yield p-value = 0.075 (good state, one-sided) and p-value = 0.421 (bad state, one-sided).

[24] Good state: p-value = 0.006 / Bad state: p-value = 0.253, Probit estimations, standard errors adjusted for clustering at the session level. Non-parametric rank-sum tests with session averages as observations yield p-value = 0.016 (good state, one-sided) and p-value = 0.210 (bad state, one-sided).

79.9 / Bad state: IA: 33.9, BL 29.7 / Overall: IA 76.9, BL: 68.9). The increase in the good state and the overall increase in buyer profits are statistically significant.[25] Accordingly, it is not surprising that buyers are less likely to choose the rigid contract in the informal agreement treatment (28 percent) than in the baseline treatment (50 percent, see FHZ for more details).[26] As shading has only small monetary consequences for sellers (the cost difference between normal and low quality is merely 5 points), the lower shading rates do not have a statistically significant impact on seller profits (IA: 25.1 / BL: 27.2).[27]

We find these results interesting. Although the trade-off between rigidity and flexibility is present in both treatments, it is less pronounced when informal agreements are available, because shading rates are lower in flexible contracts. The next section investigates in detail how informal agreements affect performance in flexible contracts.

IV.B. Informal Agreements: Effects of Non-Binding State-Contingent Price Announcements

Figure 1 illustrates how buyers make use of informal agreements. The labels on the horizontal axis categorize the different types of flexible contracts that we observe in the experiment. While "No" stands for flexible contracts in which the buyer has decided not to make a price announcement, the remaining categories indicate the level of the price announcement in contracts with informal agreements (e.g., "40" means that the buyer has announced a price in the range [35, 40], "50" stands for an announcement in the range [41,50] etc.). The bars represent the relative frequencies of price announcements in the corresponding range. Cases in which the buyer has violated the informal agreement (i.e., the actual price is lower than the price announcement) are displayed in light grey, while cases in which informal agreements have been honored (i.e., the actual price is equal to or higher than the price announcement) are displayed in dark grey. The dots represent averages of ex post prices paid by buyers for each type of flexible contract.

The figure shows that the use of informal state-contingent contracts is not very intense. More than 50 percent of the buyers who choose flexible contracts do not attach a price

---

[25] Good state: p-value = 0.044 / Bad state: p-value = 0.224 / Overall: p-value = 0.021, OLS estimations, standard errors adjusted for clustering at the session level. Non-parametric rank-sum tests with session averages as observations yield p-value = 0.075 (good state, one-sided), p-value = 0.210 (bad state, one-sided), and p-value = 0.016 (overall, one-sided).

[26] This difference is significant: p-value < 0.001, Probit regression of an indicator variable for rigid contracts on a treatment dummy for the baseline condition, standard errors adjusted for clustering at the session level.

[27] p-value = 0.340, OLS estimations, standard errors adjusted for clustering at the session level. A non-parametric rank-sum test with session averages as observations yields p-value = 0.210 (one-sided).

announcement.[28] One might suspect that there is a learning process so that buyers start to use informal agreements with experience, but this does not seem to be the case. Regressing an indicator variable for using informal agreements on period yields an insignificant coefficient close to zero (p-value = 0.445, Probit estimation, standard errors clustered at the session level). Furthermore, only relatively few of those buyers who attach a price announcement to a flexible contract make very low price announcements. Among the price announcements for the good state of the world only about 34 percent turn out to be in the range between 35 and 40, while the majority is higher (about 32 percent of the announcements are in the range between 41 and 50, the remaining 34 percent are higher than 50). Price announcements for the bad state, in contrast, are more likely to be low. About 74 percent of the announcements are in the range between 95 and 100 and only about 11 percent of the announcements are higher than 110. However, only about 25 percent of buyers who attach informal agreements make low price announcements for both states (i.e., between 35 and 40 for the good state and between 95 and 100 in the bad state).

Figure 1 also indicates that buyers who make high price announcements are more likely to pay high prices. This is true for both states of the world (Spearman's Rho for the correlation between prices and price announcements is 0.33 in the good state and 0.53 in the bad state). However, despite the positive correlation average prices exceed price announcements only as long as price announcements are relatively low. When price announcements are high, average prices are below price announcements and buyers are therefore more likely to violate their informal agreement with the seller (see the increasing trend in the light grey bars in Figure 1).

Why do so many buyers not attach a price announcement if they pick a flexible contract? To shed more light on this we now explore how sellers react to informal agreements. The hypothesis that informal state-contingent contracts allow buyers to manage sellers' expectations suggests that buyers might be able to reduce seller aggrievement and shading if they announce explicitly that they plan to pay low prices. The idea is that sellers who agree to such a contract know what to expect and do not feel aggrieved if the buyer sticks to his announcement. The first column of Table 4 takes a first step to investigate the relevance of this hypothesis in our data set. The column reports a regression of an indicator variable for

[28] For the figure we have separated observations by the ex post realized state of the world. If we consider ex ante decisions of buyers for all contracts, we observe that 53 percent of the buyers who choose a flexible contract do not make use of the possibility to attach a state-contingent price announcement.

shading on prices and price announcements in the good state of the world. The regression includes only observations in which the buyer has attached a price announcement to a flexible contract. The significantly positive coefficient of price announcements confirms that when controlling for the final price a lower price announcement significantly reduces the probability that the seller engages in shading (p-value = 0.007, Probit estimation (marginal effects reported), standard errors clustered at the session level). In addition, the coefficient of the price has a negative sign indicating that sellers are less likely to engage in shading when buyers pay higher prices. However, the price effect is not statistically significant (p-value = 0.273). Column (2) performs the same analysis for the bad state of the world. The results are similar: again the coefficient of the price has a negative sign, while price announcements have a positive sign. However, this time the price effects are statistically significant (p-value = 0.007), while the effects of price announcements are not (p-value = 0.218).

While the regressions of columns (1) and (2) of Table 4 are a useful starting point, we find it important to dig a bit deeper. In particular, since we know that buyers who announce higher prices are more likely to renege on their announcement (see Figure 1), it is interesting to examine the role of violations of informal agreements for quality choices of sellers. A simple comparison of shading rates in flexible contracts with informal agreements reveals that in the good state the shading rate is about 0.09 in contracts in which the buyer complies with his price announcement and about 0.25 in contracts in which the buyer violates the informal agreement. In the bad state the corresponding numbers are 0.11 and 0.48. In columns (3) and (4) of Table 4 we assess the statistical significance of these differences. To this end we regress the shading dummy on prices and an indicator variable which is unity in case of underbidding of a price announcement. As in columns (1) and (2) the regressions include only observations in which a price announcement was attached to a flexible contract. Column (3) investigates the good state of the world, while column (4) contains the analysis for the bad state. Both regressions confirm that the increase in the shading rate is statistically significant (Good state: p-value = 0.005, Bad state: p-value 0.028, Probit estimations (marginal effects reported), standard errors clustered at the session level). The results presented in columns (1) to (4) support the interpretation that price announcements play a role for seller reference points. The same ex post price is less likely to trigger shading activities if the buyer previously announced a low price and does not underbid his own announcement. Since sellers seem to respond to price announcements, we cannot explain the buyers' reluctance to attach announcements to flexible contracts by a lack of effect of such announcements.

To make progress, we next investigate how sellers respond to the lack of an explicit price announcement in flexible contracts. Columns (5) and (6) of Table 4 are helpful to address this question. In these regressions we include observations from all flexible contracts (with and without informal agreements). We regress an indicator variable for shading on an indicator variable which is unity if the buyer made a low price announcement in both states (i.e., price announcement ≤ 40 in the good state, and a price announcement ≤ 100 in the bad state) and an indicator variable which is unity if the buyer made a high announcement (i.e., price announcement > 40 in the good state, or price announcement > 100 in the bad state). In line with our previous analysis we see that flexible contracts with high price announcements (which often lead to violations of informal agreements) lead to higher shading rates relative to contracts without announcements in both states of the world. While this effect is highly significant in the good state (p-value = 0.005), it is not significant in the bad state (p-value = 0.371). More surprisingly, however, these regressions also show that when controlling for the price level flexible contracts with low price announcements do not lead to different shading levels than flexible contracts without price announcements. The coefficient in column (5) which identifies the effect for the good state is essentially zero and not significant (p-value = 0.963, Probit estimation (marginal effects reported), standard errors clustered at the session level), while the effect for the bad state in column (6) is insignificantly positive (p-value = 0.706). This result is compatible with the following interpretation: sellers do not expect buyers who refrain from making explicit price announcements to pay higher prices than the ones who explicitly say that they plan to pay low prices. In this sense sellers seem to interpret the lack of an explicit price announcement as an implicit message that the buyer has no intention to pay a high price.[29] In light of this evidence, buyers who decide not to attach an explicit price announcement to a flexible contract do not seem to be making a mistake. In addition, this finding also implies that flexible contracts without a price announcement in the informal agreement treatment are not equivalent to the same contracts in the baseline treatment. Combining observations of flexible contracts without announcements from the baseline and informal agreement treatment and regressing an indicator variable for shading on

[29] The finding that sellers seem to interpret the absence of an informal agreement as a signal that the buyer plans to pay a low price may partly be driven by our experimental procedures. In order to clarify the procedures of the decision making process for the participants our written instructions explain the presence of the opportunity to attach informal agreements to flexible contracts in great detail. In this sense, the availability of these agreements is very salient for the participants. As a consequence, the absence of an informal agreement may be interpreted somewhat differently in the experiment than in a situation outside of the lab in which the availability of such agreements would be less obvious.

a treatment dummy reveals that the shading rate is lower in the informal agreement treatment (p-value < 0.001 (good state), p-value = 0.179 (bad state), see also Tables 2 and 5).

Finally, Figure 2 and Table 5 allow us to compare different types of flexible contracts with rigid contracts. Figure 2 displays shading frequencies (grey bars), average prices (dots), average lower bounds (solid lines), and average price announcements (dotted lines) for rigid contracts, flexible contracts without informal agreements (NoIA), flexible contracts with low price announcements (LowIA), and flexible contracts with high price announcements (HighIA). Table 5 provides the corresponding numbers and adds a comparison of auction outcomes and buyer and seller profits across all different kinds of observed contracts. The figure and the table show that when viewed from the buyer perspective rigid contracts dominate all kinds of flexible contracts in the good state of the world. Prices (39.8) and the shading rate (0.05) are lowest, so that buyer profits are highest (98.2). Regressions of buyer profits on indicator variables for the different kinds of flexible contracts (NoIA, LowIA, and HighIA) reveal that in the good state buyer profits in rigid contracts are significantly higher than buyer profits in all kinds of flexible contracts (NoIA: 90.1, p-value = 0.045, HighIA: 81.9, p-value = 0.007, LowIA: 91.2, p-value = 0.071, OLS estimations, standard errors clustered at the session level).[30] In the bad state, in contrast, rigid contracts do not allow for trade (average buyer profit = outside option = 10) and therefore flexible contracts are always more profitable for buyers (NoIA: 35.9, LowIA: 37.1, HighIA: 21.2). However, the advantage of rigid contracts in the good state is large enough to offset the disadvantage in the bad state, i.e., overall (across both states) buyer profits in rigid contracts (78.2) are not significantly different from buyer profits in any type of flexible contract (NoIA: 79.1, p-value = 0.824, LowIA: 81.6, p-value = 0.469, HighIA: 71.9, p-value = 0.199, OLS estimations, standard errors clustered at the session level).[31]

IV.C. Informal Agreements: Discussion

We find that the availability of informal agreements changes how sellers assess the fairness of outcomes. On the one hand, ex ante announcements create obligations. If buyers opportunistically deviate by picking lower prices than announced, sellers feel shortchanged

[30] Non parametric signed-rank tests using session averages as observations yield p-value = 0.031 (NoIA, one-sided), p-value = 0.063 (LowIA, one-sided), and p-value = 0.031 (HighIA, one-sided).

[31] Non parametric signed-rank tests using session averages as observations yield p-value = 0.406 (NoIA, one-sided), p-value = 0.500 (LowIA, one-sided), and p-value = 0.156 (HighIA, one-sided).

and engage in shading. On the other hand, informal agreements also allow buyers to manage expectations to a certain extent. If buyers indicate that they are not willing to pay a high price, sellers are less likely to engage in shading in response to a low final price than in the baseline treatment where price announcements are not feasible. Sellers seem to be more likely to perceive a given price as acceptable if it is in accordance with the buyer's ex ante stated announcement. This suggests that an optimal strategy for a buyer would be to announce that he will pay a very low price, and stick to this—but few buyers actually do this. Interestingly, the availability of informal agreements not only changes the sellers' evaluation of outcomes when buyers make use of the opportunity to attach an explicit price announcement but also if they refrain from doing so. This suggests that once the possibility to communicate is there, not communicating is no longer possible. Not attaching a price announcement seems to be perceived as an implicit message that the buyer is not willing to pay a high price. Accordingly, the shading rate in flexible contracts without price announcements is very similar to the one in contracts with low price announcements. The overall lower shading in flexible contracts increases their attractiveness for buyers relative to the baseline condition. As a consequence, buyers are less likely to choose rigid contracts when informal agreements are available. However, it is important to emphasize that the decrease in shading rates in flexible contracts is only moderate and not sufficient to eliminate the trade-off between contractual rigidity and flexibility.

How surprising are these results? Hart and Moore (2008) point out that the idea of managing reference points through informal agreements has some force. However, they argue that the presence of asymmetric information in combination with self-serving biases may limit the impact of such agreements considerably. The reason is that each party may be able to convince himself that the state is favorable to him, so that there are still conflicting entitlements that trigger shading. Our results illustrate that (at least in certain environments) the effects of informal agreements may be rather small even in the absence of asymmetric information. In our setup both parties are fully informed about the cost level of the seller as soon as the computerized random device has determined the state. Accordingly, it is hard to see how self-serving biases in the interpretation of the state can play any role in the experiment. In addition, our setup is very simple, in the sense that there is no uncertainty about buyer values and only two possible realizations of seller costs. This makes state-contingent informal agreements straightforward, because it is sufficient to determine a price for each of the two cost levels. We think it is therefore fair to say that we implement an

environment in which informal agreements have a very good chance to have large effects. In this sense the fact that we find a weak impact of informal agreements is a strong result.

It is interesting to contrast our results with the findings of a recent study by Brandts et al. (2012) who (independently from us) also investigate how communication affects the frequency and effectiveness of flexible and rigid contracts. Similarly to us, they find that rigid contracts are superior to flexible contracts in the absence of communication, but in their setup allowing for communication renders flexible contracts more profitable than rigid contracts. We find it important to emphasize that their findings are not necessarily contradictory to ours, because there are key differences between the two experiments. First, Brandts et al. (2012) study a situation without ex ante competition. But according to Hart and Moore (2008), ex ante competition may be crucial to the extent that it is the objectivity added by the market that turns the contract into a salient reference point. Interestingly, the fact that Brandts et al. (2012) observe the trade-off between rigidity and flexibility even in the absence of competition suggests that contractual reference points may be more broadly applicable than hypothesized before. However, the trade-off between rigidity and flexibility is less pronounced than in our baseline condition where competition is present. Second, in contrast to the structured price announcements in our experiment, Brandts et al. (2012) allow for two-way, free-form communication over the full duration of the trading phase (i.e., communication is not only feasible ex ante when contracts are concluded, but also ex post when the final terms and performance are determined). These extensive communication possibilities seem to allow the parties to reduce disagreements so that flexible contracts become more attractive. However, whether these powerful communication effects extend to settings beyond the purely bilateral trading considered by Brandts et al. (2012) is not clear. In a competitive setting in which a buyer faces multiple potential sellers unstructured two-way communication would become very burdensome as the buyer would need to communicate with many possible trading partners simultaneously. In addition, competitive pressure would introduce incentives for strategic communication, i.e., in order to get a contract sellers might make statements ex ante that they no longer feel committed to when they move on to the bilateral ex post bargaining stage. The interplay between the various forces at work in such complex environments calls for future research.

IV.D. Renegotiation: Effects of Ex ante Contracts When Renegotiation is Not Initiated

As a first step in the analysis of our renegotiation treatment, we address the question of whether contracts still shape expectations and entitlements even if the trading parties know that renegotiation is always feasible (see Section III.B for a detailed discussion). Columns (1) to (4) of Table 6 summarize the results in non-renegotiated rigid and flexible contracts. The table indicates average prices, relative frequencies of shading, auction outcomes, and profits of buyers and sellers. As in our other treatments we find that in both types of contracts the auction outcomes are slightly above the competitive prediction of 35 on average (Fixed price: 39.8 / Lower Bound: 38.7), but they converge to the competitive level over time.[32] In line with the hypothesis that contracts also shape reference points when renegotiation is available we find that in the good state of the world prices and shading rates are higher in flexible contracts (42.2 / 0.09) than in rigid contracts (38.5 / 0.04). As a consequence, buyers make higher profits in rigid contracts (99.8) than in flexible contracts (94.4).

Table 7 reports regressions that assess the statistical significance of these results. In column (1) we regress prices in the good state of non-renegotiated contracts on an indicator variable for rigid contracts. The regression reveals that the price difference is significant (p-value = 0.016, OLS estimation, standard errors clustered at the session level).[33] Columns (2) and (3) show that the difference in shading rates across types of contracts is not statistically significant (not controlled for prices: p-value = 0.239 / controlled for prices: p-value = 0.250, Probit estimations, marginal effects reported, standard errors clustered at the session level).[34] Column (4), however, confirms that the difference in buyer profits is significant (p = 0.049, OLS estimation, standard errors clustered at the session level).[35]

Table 6 also reports outcomes for the bad state of the world. While non-renegotiated rigid contracts do not allow for trade and yield the outside option of 10, flexible contracts exhibit an average price of 96.1 and a shading rate of 11 percent, so that buyer profits amount to 39.4. This higher profit in the bad state offsets the disadvantage of flexible contracts in the

---

[32] While the first 5 periods yield average auction outcomes of 43.1 (rigid contracts) and 41.6 (flexible contracts), the corresponding values in the final 5 periods are 36.2 (rigid contracts) and 35.9 (flexible contracts). These negative time trends are statistically significant. OLS regressions of auction outcomes on period reveal significantly negative time trends for both types of contracts (p-value < 0.01, standard errors clustered at the session level).

[33] A non-parametric signed-rank test with session averages as observations yields p-value = 0.031 (one-sided).

[34] A non-parametric signed-rank test with session averages as observations yields p-value = 0.156 (one-sided).

[35] A non-parametric signed-rank test with session averages as observations yields p-value = 0.063 (one-sided).

good state, so that rigid and flexible contracts yield very similar expected overall profits for buyers (Rigid: 81.8 / Flexible: 79.4).[36] Sellers who succeed in accepting flexible contracts realize higher profits (20.5) than sellers who obtain rigid contracts (26.5), because they benefit from higher prices in the good state and trade opportunities in the bad state.

Our comparison of non-renegotiated rigid and flexible contracts illustrates that rigid and flexible ex ante contracts also have different implications for ex post behavior even if all market participants are aware that renegotiation is always feasible. This is interesting because it suggests that the availability of renegotiation does not eliminate contractual reference points. However, in order to get a more complete understanding of how the presence of renegotiation opportunities affects trade in non-renegotiated contracts, it is also insightful to compare these outcomes to the outcomes of the baseline treatment of FHZ, where the trading parties do not have the possibility to renegotiate contracts. This is what we do next.

A comparison of columns (1) and (2) with columns (5) and (6) in Table 7 shows that outcomes in non-renegotiated rigid contracts in the renegotiation treatment and outcomes in rigid contracts of the baseline treatment are similar. In both treatments buyers get away with low prices and low shading rates in the good state. In fact, if anything, we observe that lower prices (RG: 38.5 / BL: 40.7) and lower shading rates (RG: 0.04 / BL: 0.06) lead to higher buyer profits in the renegotiation treatment than in the baseline condition.[37] This reinforces our interpretation that the presence of renegotiation opportunities does not induce sellers to hope for outcomes outside the contract. Even though sellers know that buyers can renegotiate the contract and increase the price at no cost, they do not seem to expect them to do that.

In flexible contracts, however, the availability of renegotiation affects outcomes considerably. Comparing columns (3) and (4) to columns (7) and (8) in Table 7 contrasts outcomes in non-renegotiated flexible contracts in the renegotiation treatment with outcomes in flexible contracts in the baseline treatment. In the good state we observe that prices (RG:

---

[36] It does not make sense to compare observed overall profits. The reason is that renegotiation is not equally likely in the good and the bad state, so that the empirical weights of observations are distorted. The numbers for overall profits reported in Table 6 are therefore weighted averages of profits in the good and the bad state of the world.

[37] Regressions of prices (OLS), shading (Probit), and buyer profits (OLS) on a treatment dummy show that the differences in prices and profits are significant, while the difference in shading is not (Price: p-value = 0.067 / Shading: p-value = 0.349 / Buyer profits: p-value = 0.007, standard errors clustered at the session level). The difference in shading remains insignificant if we control for the price level in the corresponding regression (p-value = 0.426). Non-parametric rank-sum tests using session averages as observations yield p-value = 0.056 (prices, two-sided), p-value = 0.690 (shading, two-sided), and p-value = 0.016(buyer profits, two-sided).

42.2 / BL: 51.1) and shading rates (RG: 0.09 / BL: 0.25) in the renegotiation treatment are substantially lower, so that buyer profits (RG: 94.4 / BL: 79.9) are much higher. All these differences are highly significant.[38] The effects in the bad state are very similar. Also here prices (RG: 96.1.2 / BL: 98.4) and shading rates (RG: 0.11 / BL: 0.30) are lower in the renegotiation condition, and profits of buyers increase considerably (RG: 39.4 / BL: 29.7). Again all differences are significant.[39] These differences suggest that the availability of renegotiation affects sellers' perception of outcomes in non-renegotiated flexible contracts. Sellers seem to be more willing to accept low prices in flexible contracts if they know that the seller has the possibility to renegotiate the contract. That the price plays a less significant role for sellers' shading decision can also be seen from the fact that higher prices no longer reduce shading significantly (see column (3) of Table 7). A possible explanation for this effect is that the presence of the renegotiation possibility shifts part of the sellers' focus away from prices to the renegotiation decision itself, i.e., there may be sellers who find all outcomes acceptable as long as the buyer does not take advantage of his possibility to renegotiate the contract in opportunistic ways.[40] We will further look into this possibility when we investigate the consequences of renegotiation decisions in the following section.

IV.E. Renegotiation: Effects of Renegotiation on Ex post Performance

In this section we analyze the impact of renegotiation decisions on ex post performance. We start with mutually beneficial renegotiations. Figure 3 and Table 8 summarize outcomes in non-renegotiated and renegotiated rigid and flexible contracts across both states of nature. Figure 3 displays shading frequencies (grey bars), average prices (dots), and average lower

---

[38] Regressions of prices (OLS), shading (Probit), and buyer profits (OLS) on a treatment dummy show that the all differences are highly significant (Price: p-value < 0.001 / Shading: p-value < 0.001 / Buyer profits: p-value < 0.001, standard errors clustered at the session level). The difference in shading is, of course, also significant if we control for the price level in the corresponding regression (p-value < 0.001). Non-parametric rank-sum tests using session averages as observations yield p-value = 0.008 (prices, two-sided), p-value = 0.008 (shading, two-sided), and p-value = 0.008 (buyer profits, two-sided).

[39] Regressions of prices (OLS), shading (Probit), and buyer profits (OLS) on a treatment dummy show that the all differences are significant (Price: p-value = 0.015 / Shading: p-value < 0.041 / Buyer profits: p-value < 0.014, standard errors clustered at the session level). The difference in shading is even more significant if we control for the price level in the corresponding regression (p-value < 0.002). Non-parametric rank-sum tests using session averages as observations yield p-value = 0.095 (prices, two-sided), p-value = 0.158 (shading, two-sided), and p-value = 0.056(buyer profits, two-sided).

[40] The effect that sellers seem to focus away from prices to the renegotiation decision itself may be more accentuated in our laboratory setting than in real-world contexts. The reason is that the possibility of renegotiation is very salient in the experiment. The written instructions to the experiment explain the renegotiation opportunity and its consequences for the feasible outcomes in much detail. In many real-world settings the possibility of renegotiation may not be as prominent in trading parties' mind and they may therefore concentrate more on the realized outcome within the bounds of the contract.

bounds (solid lines). Table 8 provides the corresponding numbers and adds information about auction outcomes and buyer and seller profits for all different kinds of observed contracts. The figure and the table show that in the bad state the average price (97.3), the shading rate (0.10), and average buyer profits (38.8) in renegotiated rigid contracts are very similar to the corresponding values in flexible contracts (96.1 / 0.11 / 39.4). The regression analysis in Table 9 confirms that neither of these differences is statistically significant (Prices: p-value = 0.139 (OLS), Shading: p-value = 0.814 (Probit), Buyer profits: p-value = 0.871 (OLS), standard errors clustered at the session level).[41] These observations suggest that mutually beneficial renegotiations do not have important psychological implications on their own. It rather seems that they just turn a rigid contract into a flexible one and trigger the corresponding behavior on the seller side (see also the discussion in Section III.B). Obviously, mutually beneficial renegotiation are a very attractive option for buyers who have chosen rigid contracts. The realized buyer profit in trades permitted by renegotiated rigid contracts (38.8) is much higher than the outside option of 10 that the buyer realizes if he doesn't renegotiate the contract. Accordingly, it is not a big surprise that the vast majority of rigid contracts (78 percent) are renegotiated when it turns out that the state of the world is bad.

We now turn to opportunistic renegotiation. Figure 3 and Table 8 show that renegotiations, which buyers undertake to grab a bigger share of the gains from trade, lead to very high shading rates (Rigid: 0.50 / Flexible: 0.45). In general, the buyers' attempts to push down prices to low levels (Rigid: 37.5 / Flexible: 37:3), results in rather low profits (Rigid: 82.5 / Flexible: 84.7). Table 10 provides the associated regression analysis. In column (1) we use the data from rigid contracts and regress an indicator variable for shading on an indicator variable for opportunistic renegotiation, while controlling for the price level.[42] Column (2) reports the same regression for flexible contracts. Both regressions show that shading rates for a given price are significantly higher if the price is the result of an opportunistic renegotiation than if the price has been determined within the bounds of an existing contract (p-value < 0.001 for both contract types, standard errors clustered at the session level). These findings reinforce our earlier interpretation that the sellers put considerable weight on the buyer's renegotiation decision when they evaluate the fairness or acceptability of ex post outcomes.

---

[41] Non-parametric signed-rank tests with session averages as observations yield p-value = 0.625 (prices, two-sided), p-value = 0.438 (shading, two-sided), p-value = 0.438 (buyer profits, two-sided).

[42] The regression contains only observations in which there was either no renegotiation or an opportunistic renegotiation, i.e., we exclude observations in which buyers initiated renegotiation in the good state to increase the price voluntarily ("altruistic" renegotiations).

In columns (3) and (4) we compare buyer profits in non-renegotiated and opportunistically renegotiated contracts, while controlling for the final price. We find that buyer profits are significantly lower if the price has been determined by opportunistic renegotiation than if the price has been realized within the bounds of an ex-ante determined contract. In rigid contracts opportunistic renegotiation reduces buyer profits by about 18 points, in flexible contracts the reduction amounts to about 14 points (Rigid: p-value = 0.058 / Flexible: p-value < 0.001, OLS estimation, standard errors clustered at the session level).

However, it seems that most buyers are aware of the negative consequences of opportunistic renegotiation. Overall, only about 5 percent of the rigid contracts and about 7 percent of the flexible contracts in which the good state has been realized are subject to opportunistic renegotiation (see also Table 8). Moreover, Figure 3 shows that contracts are more likely to be opportunistically renegotiated if auction outcomes (i.e., fixed prices or lower bounds of the price range) are high. A regression of an indicator variable for opportunistic renegotiation on the auction outcome confirms that there is a significantly positive impact of a higher auction outcome on the probability of opportunistic renegotiation.[43] This makes sense as high auction outcomes imply that sticking to the contract results in a low buyer profit.

Finally, we also observe "altruistic" renegotiations in a small number of rigid contracts (about 5 percent of the cases in which the good state has been realized in a rigid contract, see Table 8). By "altruistic" renegotiation we mean cases in which the buyer renegotiated the contract and increased the price although the good state had been realized and trade would have been possible at the fixed price defined in the contract. Not surprisingly, the affected sellers seem to perceive these choices as generous and do not engage in shading.

IV.F. Renegotiation: Discussion

The data from non-renegotiated contracts indicate that rigid and flexible contracts continue to have different implications for ex post performance in the presence of renegotiation. In particular, it is still true that buyers who have picked a rigid contract can, on average, pay lower prices without lowering quality, and hence can realize higher profits in the good state of the world. Sellers do not seem to hope for outcomes which would be feasible only if the buyer renegotiated the contract. We think that this is a strong result. In this treatment the buyer's

[43] Probit estimation, standard errors adjusted for clustering at the session level: p-value < 0.001. The effects remains significant if the regression is performed for each type of contract separately.

contract choice has ultimately no consequence for the feasible outcomes (the buyer can always renegotiate for free and pick any price $p \in [c(q_l,\sigma) + x_s, v(q^n)]$). This implies that our design essentially turns the buyer's contract choice into a pure framing decision. Nevertheless, the contract still serves as a salient reference point. This makes it likely that contractual reference points have also important implications in more realistic situations, in which renegotiation of contracts is typically much more difficult and/or costly.

We also find that mutually beneficial renegotiations are relatively unproblematic. If a rigid contract does not allow for trade because the price is lower than the seller's cost, the buyer can renegotiate the price upwards. While the newly introduced flexibility in the ex post price choice leads to some shading, the profits from trade are still much higher than the outside option and are in line with those from a flexible contract. Therefore, in our renegotiation treatment, rigid contracts perform significantly better than flexible contracts: they yield higher profit in the good state and comparable profit in the bad state.

It is interesting to relate these results to a recent study by Bartling and Schmidt (2012). In their main treatment (the contract condition) they implement a setup in which a buyer and a seller agree on the terms of trade without knowing the optimal time of delivery yet. If ex post information reveals that there is a better delivery time than the one the parties have agreed upon ex ante, the buyer can ask for a change in the delivery time. In response the seller can ask for a markup on the original price. To investigate the role of the ex ante contract for the renegotiation phase, they compare the contract condition with a treatment in which the same threat points which endogenously emerge in the main treatment are exogenously imposed on the trading parties (the no-contract condition). They find that sellers ask for much lower markups and buyers are more likely to reject given markups in the contract condition than in the no-contract condition. These findings suggest that the initial contract serves as an important reference point.[44] Moreover, these results are in line with our finding that renegotiations are quite unproblematic as long as they are mutually beneficial (which is typically the case if the sellers ask for a low markup in response to the buyer's request for a change in the delivery time), but lead to counterproductive conflicts if one of the parties feels that the other party misuses renegotiation for opportunistic reasons (which is the case if the seller asks for a high markup).

[44] See also Hoppe and Schmitz (2011) who show a similar effect in the context of renegotiable option contract.

Finally, as there are always different ways to design a particular treatment, we would like to point out some limitations of our design choices. First, in our setup a seller is forced to trade with a buyer even after the buyer has unilaterally renegotiated the contract. We proceeded this way because we did not want a seller to have a more powerful punishment device (refusing trade) after renegotiation has been initiated than otherwise. However, although our procedures guarantee that the seller always receives at least his outside-option, some sellers might have preferred to walk away from trade, had we given them the opportunity to do so (in particular, after opportunistic renegotiation). As a consequence, our data may actually underestimate the negative effects of opportunistic renegotiations.

Second, our data provide the interesting insight that mutually beneficial renegotiations of rigid contracts essentially lead to the same ex post outcomes as flexible contracts. To cleanly establish this result, we had to ensure that there is the same degree of flexibility in renegotiated rigid contracts and flexible contracts. For this reason we implemented identical upper bounds for prices in both cases ($p^u = v(q^h) = 140$). A side-effect of this design choice is that rigid contracts look extremely attractive in our setup. Buyers who choose rigid contracts not only benefit from lower prices and lower shading rates in the good state, but they can also renegotiate their contracts if necessary and realize the same outcomes as buyers with flexible contracts in the bad state. It is important to emphasize, however, that this is not a comparison of optimal contracts. In FHZ we show that lowering the upper bound of the price range in flexible contracts to the lowest possible level that still allows for trade in both states ($p^u = c(q^l,b) + x_S = 95$), increases the attractiveness of flexible contracts for buyers considerably, because it minimizes the shading rate in the bad state. Had we compared renegotiable rigid contract with such limitedly flexible contracts, the choice of rigid contracts would again have involved a trade-off, because flexible contracts would have yielded better results in the bad state.

Another potential limitation of our design is that it allows only the buyer to initiate renegotiation. We think that it would also be interesting to study situations in which two-sided renegotiation is possible. However, in order to make such a treatment interesting, we would require that the buyer has ways to harm the seller by shading on performance, and also that the buyer's value is uncertain. It is obvious that two-sided shading and uncertainty about values and costs would considerably complicate the strategic considerations in the experiment. We leave this interesting extension for future work.

V. Conclusions

In this paper we show experimentally that the central behavioral mechanism underlying the concept of behavioral reference points is robust to the availability of informal agreements and ex post renegotiation. Taken together, the two experiments reported in this paper provide further evidence in line with the idea that contractual reference points importantly shape performance in trading relationships governed by incomplete contracts. Our evidence also suggests refinements of the theory. Perhaps most important our data reveal that contract renegotiation is a more nuanced process than the previous literature has recognized. For example, it is sometimes better for parties to write a simple (rigid) contract and then renegotiate ex post if needed, rather than to anticipate and include future contingencies in a (flexible) contract from the outset.

It is worth (re-)emphasizing some limitations of our work. In our informal agreements treatment we have restricted attention to particular types of communication and we have supposed completely symmetric information between the parties. In our renegotiation treatment we have studied renegotiation in situations that are very simple, and where the temptation to renegotiate opportunistically is low. Investigating the robustness of our results in richer environments is an important topic for future research.

References:

Bartling, Bjoern, and Klaus Schmidt. 2012. "Reference Points in Renegotiations: The Role of Contracts and Competition." Working Paper.

Brandts, Jordi, Gary Charness, and Matthew Ellman. 2012. "Let's talk: How communication affects contract design." Working Paper.

Charness, Gary, and Matthew Rabin. 2002. "Understanding Social Preferences with Simple Tests." *Quarterly Journal of Economics,* 117(3): 817–69.

Falk, Armin, Ernst Fehr, and Urs Fischbacher. 2003. "On the Nature of Fair Behavior." *Economic Inquiry*, 41(1): 20-26.

Fehr, Ernst, and Simon Gaechter. 2000. "Cooperation and Punishment in Public Goods Experiments. " *American Economic Review*, 90(4): 980-994.

Fehr, Ernst, Lorenz Goette, and Christian Zehnder. 2009. "A Behavioral Account of the Labor Market: The Role of Fairness Concerns." *Annual Review of Economics*, 1: 355-84.

Fehr, Ernst, Oliver Hart, and Christian Zehnder. 2009. "Contracts, Reference Points, and Competition – Behavioral Effects of the Fundamental Transformation." *Journal of the European Economic Association*, 7(2-3): 561-72.

Fehr, Ernst, Oliver Hart, and Christian Zehnder. 2011. "Contracts as Reference Points - Experimental Evidence." *American Economic Review*, 101(2): 493-525.

Fischbacher Urs. 2007. "z-Tree: Zurich Toolbox for Ready-made Economic Experiments." *Experimental Economics*, 10(2): 171-178.

Greiner, Ben. 2004. "An Online Recruiting System for Economic Experiments." In *Forschung und wissenschaftliches Rechnen 2003. GWDG Bericht 63*, ed. Kurt Kremer and Volker Macho, 79-93. Göttingen: Ges. für Wiss. Datenverarbeitung.

Hart, Oliver. 2009. "Hold-Up, Asset Ownership, and Reference Points." *Quarterly Journal of Economics*, 124(1): 267-300.

Hart, Oliver, and Bengt R. Holmstrom. 2010. "A Theory of Firm Scope." *Quarterly Journal of Economics* , 125(2): 483-512.

Hart, Oliver, and John Moore. 2008. "Contracts as Reference Points." *Quarterly Journal of Economics*, 123(1): 1-48.

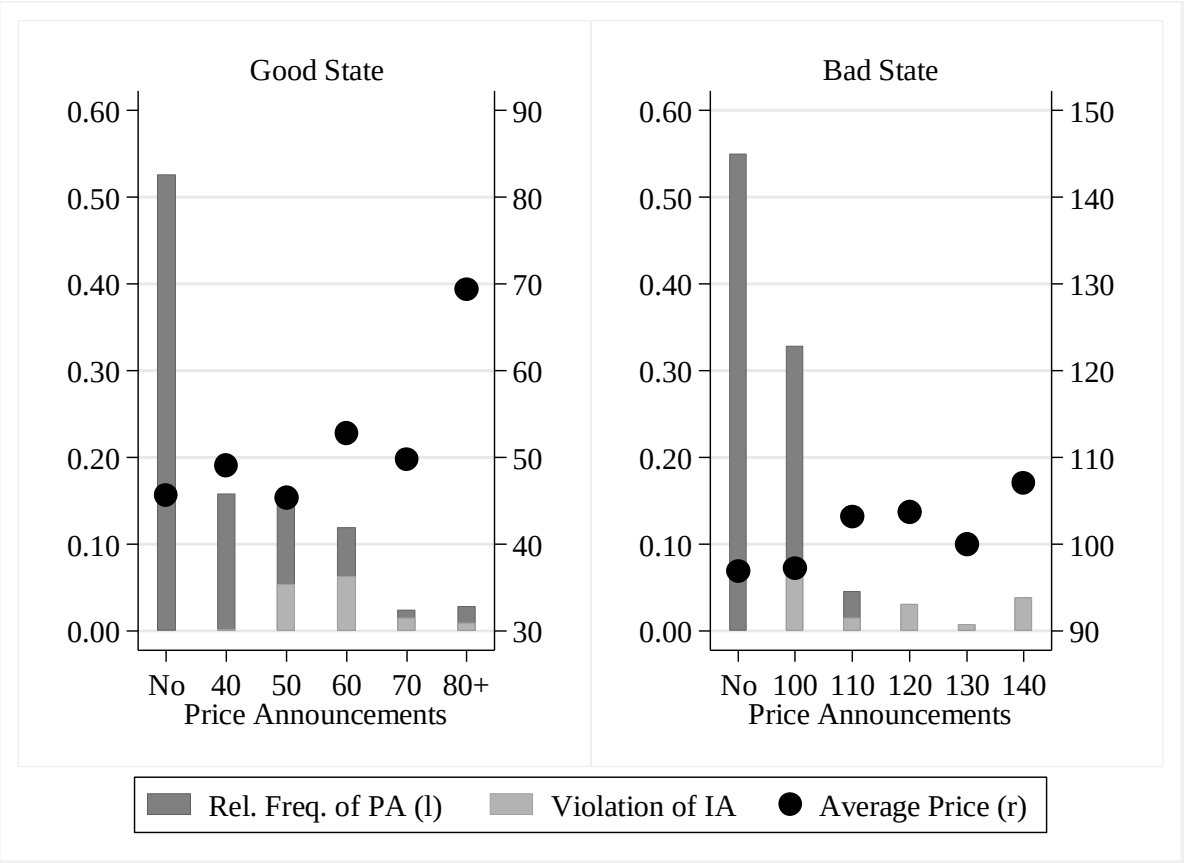
Hoppe, Eva, and Patrick Schmitz. 2011. "Can Contracts Solve the Hold-Up Problem? Experimental Evidence. ", *Games and Economic Behavior*, 73(1), 186-199.

Klein, Benjamin. 1996. "Why Hold-Ups Occur: The Self-Enforcing Range of Contractual Relationships." *Economic Inquiry*, 34(3): 444–463.Klein (1996)

Maskin, Eric, and John Moore. 1999. "Implementation and Renegotiation." *Review of Economic Studies*, 66(1), 39-56.

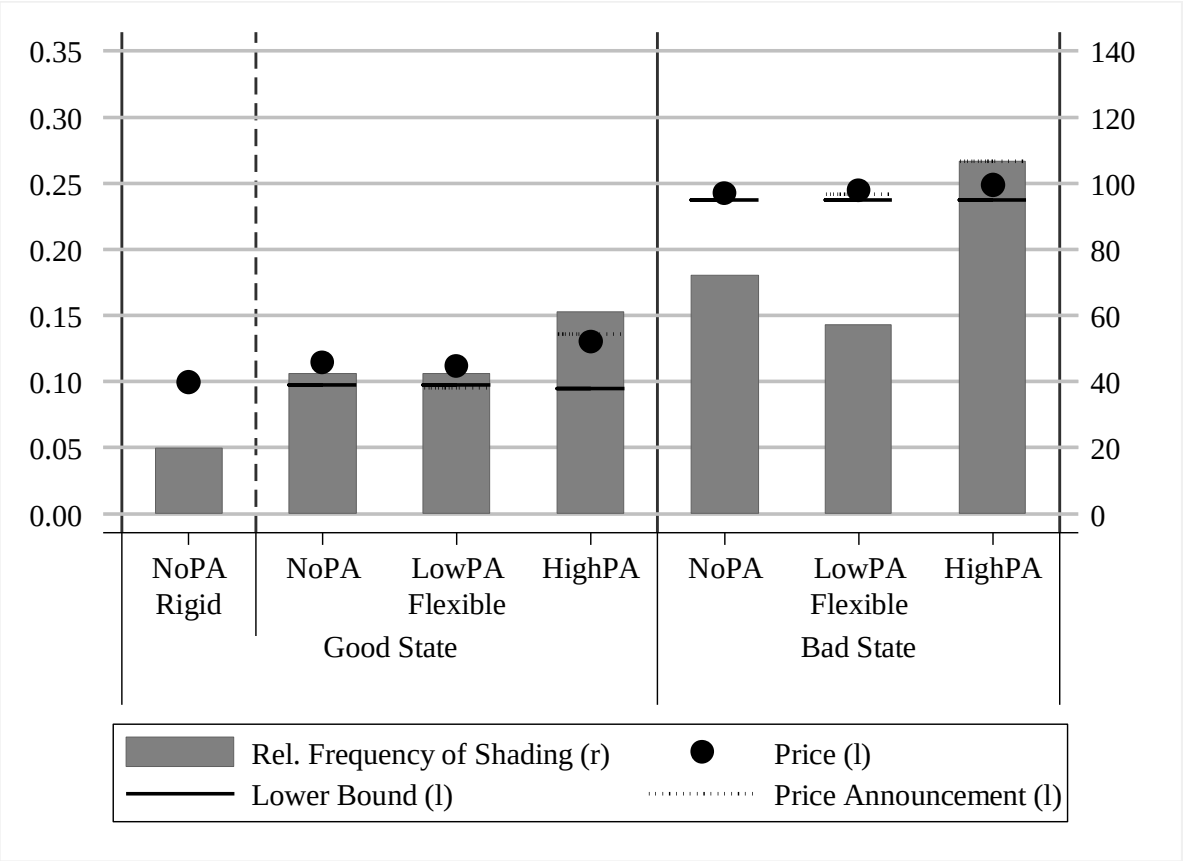
Rajan, Raghuram. 2012. "The Corporation in Finance." *Journal of Finance,* 67(4), 1173-1217.

Figure 1 (Informal Agreements): Price Announcements and Actual Prices



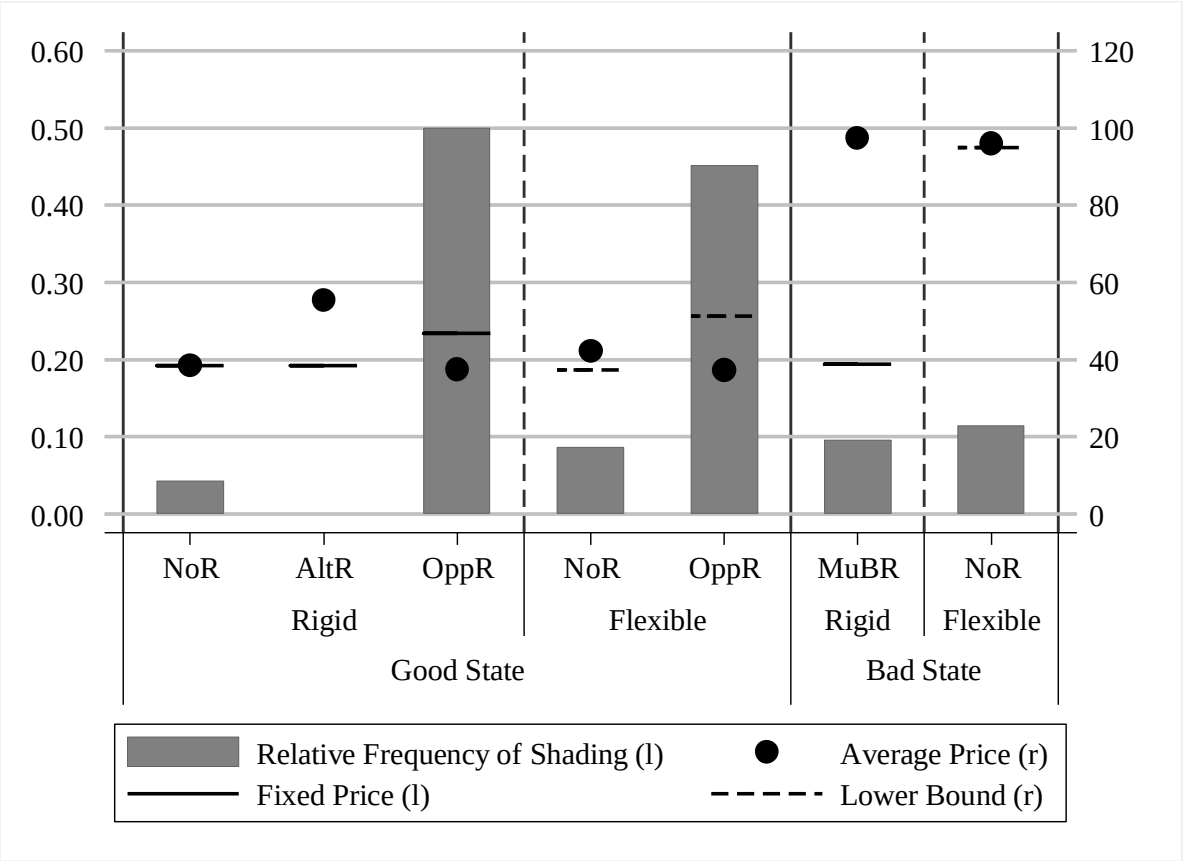
Notes: The labels of the horizontal axis categorize informal agreements. "No" indicates that the buyer has not made a price announcements. The numbers describe ranges of price announcements (e.g., "40" means 35-40, "50" means 41-50 etc., and "80+" means 71 or higher). The bars represent relative frequencies of price announcements in the corresponding range (left axis). Observations for which the actual price is smaller than the announced price (violation of informal agreements) are displayed in light gray. Averages of actual prices per range of price announcements are represented as dots (right axis).

Figure 2 (Informal Agreements): Shading Behavior in Rigid and Flexible Contracts



Notes: "NoPA" stands for "no price announcement". "LowPA" represents contracts, in which the buyer announced a low price (i.e., price announcement ≤ 40 in the good state, or price announcement ≤ 100 in the bad state). "HighPA" contains contracts, in which the buyer announced a high price (i.e., price announcement > 40 in the good state, or price announcement > 100 in the bad state). The bars represent relative shading frequencies (left axis). The solid lines display the average lower bound of the price range, dotted lines show average price announcements and dots represent average actual prices (right axis).

Figure 3 (Renegotiation): Shading Behavior in Rigid and Flexible Contracts



Notes: "NoR" stands for contracts that have not been renegotiated. "AltR" represents cases of "altruistic" renegotiations, i.e., rigid contracts in which the buyer has increased the price although the good state has been realized. "OppR" contains contracts in which the buyer has initiated opportunistic renegotiation to lower the price below the fixed price in rigid contracts or below the lower bound of the price range in flexible contracts. "MuBR" stands for mutually beneficial renegotiations. These are rigid contracts in which the buyer has increased the price to make trade feasible after the bad state has been realized. The bars represent relative shading frequencies (left axis). The solid lines display the average fixed price in rigid contracts, dashed lines show average lower bounds in flexible contracts and dots represent average actual prices (right axis).

Table 1: Experimental Parameters

State of nature	Good [Prob(s = g) = 0.8]		Bad [Prob(s = b) = 0.2]	
Seller's quality	normal ($q = q^n$)	low ($q = q^l$)	normal ($q = q^n$)	low ($q = q^l$)
Seller's costs	20	25	80	85
Buyer's valuations	140	100	140	100

Notes: The table summarizes the main parameters of the experiment. Buyers' valuations for the product and sellers' production costs are displayed for both states of nature and both quality levels available to the seller.

Table 2 (Informal Agreements / Baseline): Comparison of Contracts

Contract	Informal Agreement				Baseline			
	Rigid		Flexible		Rigid		Flexible	
State	Good	Bad	Good	Bad	Good	Bad	Good	Bad
Average Price	39.8	-	47.8	97.9	40.7	-	51.1	98.4
Rel. Freq. of Shading	0.05	-	0.13	0.21	0.06	-	0.25	0.30
Av. Auction Outcomce	39.8		38.7		40.7		40.2	
Average Profit Buyer	98.2	10.0	87.3	33.9	96.8	10.0	79.9	29.7
	78.2		76.9		77.9		68.9	
Average Profit Seller	19.5	10.0	27.2	16.8	20.4	10.0	29.8	16.9
	17.4		25.1		18.1		27.2	
Number of Observations	201	59	539	131	398	111	407	104

Notes: The table summarizes the outcomes for rigid and flexible contracts in both states of nature. "Average Price" is the average of the trading price and "Relative Frequency of Shading" measures how often the seller has chosen the low quality. For rigid contracts this information is available only for the good state, because trade does not occur in the bad state. "Average Auction Outcome" is the average of the fixed price in case of rigid contracts and the lower bound of the price range in case of flexible contracts. "Average Profit Buyer (Seller)" measures the average payoff of buyers (sellers) for each (state and) contract. In rigid contracts the payoffs in the bad state of the world are the outside options of the market participants.

Table 3 (Informal Agreements): Trade-off Between Contractual Rigidity and Flexibility

Dependent Variable State	Price Good OLS (1)	Shading Good Probit (2)	Shading Good Probit (3)	Profit Good OLS (4)	Profit Good&Bad OLS (5)
Flexible contract	7.993**	0.073***	0.082***	-10.901**	-1.326
	(2.608)	(0.018)	(0.025)	(3.198)	(4.033)
Price			-0.002**		
			(0.001)		
Constant	39.771***			98.239***	78.215***
	(0.664)			(0.877)	(2.231)
Observation	740	740	740	740	930
R^2	0.090			0.086	0.000

Notes: "Flexible contract" is an indicator variable which is unity if the contract is of the flexible type and zero otherwise. Columns (1), (4) and (5) report coefficients of OLS estimations. Columns (2) and (3) report marginal effects based on Probit estimations. Since observations within sessions may be dependent all reported standard errors are adjusted for clustering at the session level. *** p<0.01, ** p<0.05, * p<0.1.

Table 4 (Informal Agreements): Effects of Informal Agreements

Dep. Variable State	Shading Good Probit (1)	Shading Bad Probit (2)	Shading Good Probit (3)	Shading Bad Probit (4)	Shading Good Probit (5)	Shading Bad Probit (6)
Price	-0.004	-0.027***	-0.001	-0.017**	-0.004*	-0.017***
	(0.003)	(0.008)	(0.003)	(0.010)	(0.002)	(0.008)
Price Announc.	0.003***	0.008				
	(0.001)	(0.007)				
Violation of IA			0.131***	0.382**		
			(0.077)	(0.216)		
Low PA					0.002	0.019
					(0.033)	(0.046)
High PA					0.069***	0.127
					(0.033)	(0.150)
Observation	256	59	256	59	539	131

Notes: "Violation of IA" is an indicator variable which is unity if the buyer picks a final price which is below his price announcement. "Low PA" is an indicator variable which is unity if the buyer announced low prices for both states (i.e., price announcement ≤ 40 in the good state, and price announcement ≤ 100 in the bad state). "High PA" is an indicator variable which is unity if the buyer announced a high price for at least one state (i.e., price announcement > 40 in the good state, or price announcement > 100 in the bad state). All columns report marginal effects based on Probit estimations. Since observations within sessions may be dependent, all reported standard errors are adjusted for clustering at the session level. *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

Table 5 (Informal Agreements): Prices, Shading, and Buyer Profits Across Contracts

Contract	Rigid		Flexible					
			NoPA		LowPA		HighPA	
State	Good	Bad	Good	Bad	Good	Bad	Good	Bad
Average Price	39.8	-	45.7	96.8	44.5	97.9	52.0	99.5
Rel. Freq. of Shading	0.05	-	0.11	0.18	0.11	0.14	0.15	0.27
Av. Auction Outcome	39.8		39.1		38.6		38.4	
Average Profit Buyer	98.2	10.0	90.1	35.9	91.2	36.4	81.9	29.8
	78.2		79.1		81.6		71.9	
Average Profit Seller	19.5	10.0	25.1	15.9	24.0	17.1	31.3	18.2
	17.4		23.3		22.8		28.8	
Number of Observations	201	59	283	72	66	14	190	45

Notes: "NoPA" stands for "no price announcement". "LowPA" represents contracts, in which the buyer announced low prices for both states (i.e., price $\leq$ 40 in the good state, and price $\leq$ 100 in the bad state). "HighPA" contains contracts, in which the buyer announced a high price for at least one state (i.e., price > 40 in the good state, or price > 100 in the bad state). For descriptions of the variables please see the notes of Table 2.

Table 6 (Renegotiation / Baseline): Comparison of Non-Renegotiated Contracts

Contract	Renegotiation				Baseline			
	Rigid		Flexible		Rigid		Flexible	
State	Good	Bad	Good	Bad	Good	Bad	Good	Bad
Average Price	38.5	-	42.2	96.1	40.7	-	51.1	98.4
Rel. Freq. of Shading	0.04	-	0.09	0.11	0.06	-	0.25	0.30
Av. Auction Outcomce	38.6		37.3		40.7		40.2	
Average Profit Buyer	99.8	10.0	94.4	39.4	96.8	10.0	79.9	29.7
(weighted average)	81.8		83.4		79.4		69.9	
Average Profit Seller	18.3	10.0	21.7	15.5	20.4	10.0	29.8	16.9
(weighted average)	16.6		20.5		18.3		27.2	
Number of Observations	282	20	428	105	398	111	407	104

Notes: See the notes of Table 2 for a detailed description of all variables. Since renegotiation is not equally likely in the good and the bad state, we do not compare observed overall profits (the empirical weights are distorted). Instead we provide weighted averages of profits in the good and the bad state of the world (using the theoretical probabilities for the realization of each state).

Table 7 (Renegotiation): Comparison of Non-Renegotiated Rigid and Flexible Contracts

Dependent Variable	Price	Shading	Shading	Profit
State	Good	Good	Good	Good
	OLS	Probit	Probit	OLS
	(1)	(2)	(3)	(4)
Flexible contract	3.642**	0.043	0.045	-5.398**
	(0.909)	(0.038)	(0.040)	(1.925)
Price			-0.001	
			(0.001)	
Constant	38.521***			99.777***
	(0.634)			(0.618)
Observation	710	710	710	710
R^2	0.048			0.041

Notes: "Flexible contract" is an indicator variable which is unity if the contract is of the flexible type and zero otherwise. Columns (1) and (4) report coefficients of OLS estimations. Columns (2) and (3) report marginal effects based on Probit estimations. Since observations within sessions may be dependent all reported standard errors are adjusted for clustering at the session level. *** p<0.01, ** p<0.05, * p<0.1.

Table 8 (Renegotiation): Effects of Renegotiation on Prices, Shading, and Buyer Profits

Contract	Rigid					Flexible		
State	Good			Bad		Good		Bad
Renegotiation	No	Alt	Opp	No	MuB	No	Opp	No
Average Price	38.5	55.3	37.5	-	97.3	42.2	37.3	96.1
Rel. Freq. of Shading	0.04	0.00	0.50	-	0.10	0.09	0.45	0.11
Auction Outcome	38.5	38.4	46.8	39.5	38.9	37.2	51.3	37.9
Average Profit Buyer	99.8	84.7	82.5	10.0	38.8	94.4	84.7	39.4
Opt. Profit Buyer			87.6				83.4	
Average Profit Seller	18.3	35.3	15.0	10.0	16.9	21.7	15.0	15.5
Prof. Seller if Buyer opt.			18.0				20.5	
Number of Observations	282	15	16	20	63	428	31	105

Notes: "No" stands for contracts that have not been renegotiated. "Alt" represents contracts in which the buyer has initiated "altruistic" renegotiation in order to increase the fixed price of a rigid contract although the good state has been realized. "Opp" contains contracts in which the buyer has initiated an opportunistic renegotiation to lower the price below the fixed price in rigid contracts or below the lower bound of the price range in flexible contracts. "MuB" stands for mutually beneficial renegotiations. These are rigid contracts in which the buyer has increased the price to make trade feasible after the bad state has been realized. "Opt. Profit Buyer" is the expected profit of a buyer who chooses a specific contract type and behaves optimally in each state (based on observed profits). "Profit Seller if Buyer opt." is the expected profit of sellers if the buyer behaves optimally in each state.

Table 9 (Renegotiation): Effects of Mutually Beneficial Renegotiations

Dependent Variable	Price	Shading	Shading	Profit
State	Bad	Bad	Bad	Bad
	OLS	Probit	Probit	OLS
	(1)	(2)	(3)	(4)
Flexible contract	-1.273	0.019	0.000	0.511
	(0.692)	(0.079)	(0.080)	(2.956)
Price			-0.015*	
			(0.013)	
Constant	97.349***			38.841***
	(0.835)			(3.512)
Observation	168	168	168	168
R^2	0.039			0.000

Notes: "Flexible contract" is an indicator variable which is unity if the contract is of the flexible type and zero otherwise. Columns (1) and (4) report coefficients of OLS estimations. Columns (2) and (3) report marginal effects based on Probit estimations. Since observations within sessions may be dependent all reported standard errors are adjusted for clustering at the session level. *** p<0.01, ** p<0.05, * p<0.1.

Table 10 (Renegotiation): Effects of Opportunistic Renegotiations

Dep. Variable	Shading	Shading	Profit	Profit
State	Good	Good	Good	Good
Contract	Rigid	Flexible	Rigid	Flexible
	Probit	Probit	OLS	OLS
	(1)	(2)	(3)	(4)
Price	-0.002	-0.002	-1.114***	-0.951***
	(0.002)	(0.002)	(0.119)	(0.057)
Opp. Reneg.	0.469***	0.350***	-18.414*	-14.368***
	(0.168)	(0.029)	(7.010)	(1.031)
Auction Outc.				
Constant			142.679***	134.488***
			(4.093)	(2.793)
Observations	298	459	298	459
R^2			0.415	0.342

Notes: "Opportunistic Renegotiation" is an indicator variable which is unity if the buyer has initiated renegotiation in the good state of the world to either lower the price to a level below the fixed price of a rigid contract or the lower bound of the price range in a flexible contract. Columns (1) and (2) report marginal effects based on Probit estimations. Columns (3) and (4) report coefficients of OLS estimations. Since observations within sessions may be dependent, all reported standard errors are adjusted for clustering at the session level. *** p<0.01, ** p<0.05, * p<0.1.