Contracts, Conflicts and Communication

Ernst Fehr, Oliver Hart, and Christian Zehnder*

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Abstract

Previous research emphasizes that free-form communication is efficiency-enhancing, because it fosters cooperation, facilitates coordination and reduces conflicts. This paper studies an environment in which these positive effects of communication are not present. We explore a contracting situation in which competition tends to create considerable payoff inequality in favor of the buyer. Inequality poses a threat to efficiency, because sellers who end up with a small share of the surplus tend to engage in inefficient, counterproductive behavior. In the absence of communication buyers succeed in reducing conflicts by proposing rigid contracts in which the price is fixed ex ante and cannot be adapted ex post. The downside of contractual rigidity is that efficient trade is prevented in some states of the world. Our experiment tests whether the availability of free-form communication allows the parties to find a superior solution in which contractual flexibility prevails and buyers use communication to forestall conflicts. We find that this is not the case. The communication technology is predominantly used for influence activities through which sellers try to obtain a larger share of the surplus. These influence activities further increase the potential for conflicts, because sellers who fail to influence buyers respond more harshly to low prices. As a consequence, buyers minimize conflicts and maximize profits if they choose rigid contracts and refuse to communicate. Finally, additional experimental treatments show that our findings are robust to the presence of information asymmetries.

* 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 Swiss National Science Foundation (Grant No. 100018_152903).

I. Introduction

Existing research emphasizes that free-form communication among trading parties has important efficiency-enhancing effects. In particular, communication facilitates cooperation (see e.g. Capra et al. 2005, Bochet et al. 2006, Blume and Ortmann 2007, Brandts and Cooper 2007, Lundquist et al. 2009, Andersson and Wengström 2012), improves coordination (see e.g. Dawes et al. 1977, Isaac and Walker 1988, Ostrom et al. 1992, Charness and Dufwenberg 2006, Cason and Mui 2014), and helps to reduce conflicts (see e.g. Xiao and Houser 2005, Andersson et al. 2010, Brandts et al. 2016).

In this paper, however, we show that the positive effects of communication do not unfold in all situations. We study a contracting environment in which competition tends to create considerable payoff inequality in favor of buyers. Inequality threatens efficiency in our setup, because sellers who end up receiving a small share of the surplus tend to engage in counterproductive activities to hurt buyers. In the absence of communication buyers succeed in mitigating conflicts by proposing rigid contracts that fix the price at the start of the trading phase and prohibit adjustments later on. However, the lack of flexibility in these contracts comes at a cost. Because the trading partners do not yet know the seller's production cost when they conclude the contract, a low fixed price may prevent efficient trade from occurring when the cost is high. There are two reasons for why communication might help buyers to establish a superior solution that not only minimizes conflicts, but also offers the flexibility necessary to guarantee trade. First, buyers might use communication to manage sellers' ex-ante expectations. If sellers are fully aware of the buyer's price setting plans before accepting a flexible contract, an unfavorable outcome might be less disappointing. This may reduce the seller's inclination to start a conflict (see also Fehr et al. 2015 and Brandts et al. 2016). Second, even if disappointment cannot be fully avoided, buyers may use communication to justify and adequately explain their choices. Such communication might create understanding and reduce the inclination to engage in conflict (see e.g. Greenberg 1990). In this way effective communication might allow the buyer to limit conflicts without relying on overly rigid contracts.

At the same time, however, the presence of considerable payoff inequality between buyers and seller in our setup gives rise to the risk that sellers (ab)use communication for influencing activities. The literature on influence activities (see e.g. Milgrom 1988, Milgrom and Roberts 1988, Meyer et al. 1992) emphasizes that influence activities are relevant when individuals have discretion over decisions which have distributional implications. In our setup

these activities manifest themselves in that sellers try to convince buyers to pick flexible contracts and to pay high prices so that sellers get a larger share of the surplus. Instead of facilitating trade in flexible contracts, influence activities might imply that communication complicates the situation. The reason is that unsuccessful attempts to influence the buyer might induce sellers to react in hostile ways if the buyer refuses to implement a flexible contract with a high price. Milgrom and Roberts (1988) suggest that influence activities can be reduced by closing down communication channels and/or limiting the decision makers' discretion to restrict their ability to respond to influence activities. In our setting there is room for such countermeasures in that buyers might decide to block communication attempts of sellers and to choose rigid contracts in which prices can no longer be changed once they have been determined in a competitive auction among sellers.[2]

Our set-up allows us to test these competing hypotheses against each other. The design of our experiment builds on the contracting environment introduced in Fehr et al. (2011). A buyer and a seller can reach an agreement to trade a widget. Ex post trade is voluntary and only occurs if the terms of the contract allow for a mutually beneficial exchange. The buyer's value is fixed, but there is uncertainty about whether the seller's cost will be high or low. In the agreement phase the buyer needs to decide whether he prefers a rigid or a flexible contract. Contract terms are determined in a competitive auction among sellers. If the buyer picked a rigid contract, the auction directly determines a single fixed price. Ex post trade occurs at this fixed price, but only if the seller's cost turns out to be low. If the cost is high, the widget is not traded and the parties realize their outside options. In case of a flexible contract, in contrast, the auction determines the lower bound of a price range out of which the buyer can pick the final price after the seller's cost has been determined. Trade occurs as long as the price chosen by the buyer covers the seller's cost. If trade occurs, the seller can decide to provide either normal or low quality. The provision of low quality is slightly costly.

We implement a two-by-two design in which we manipulate two dimensions independently: the informational asymmetry between buyers and sellers and the availability of a communication technology. In our symmetric information treatments the seller's cost becomes common knowledge as soon as it has been determined by nature. In the asymmetric information treatments, in contrast, the buyer learns the seller's cost only with a certain

[2] As a third option Milgrom and Roberts (1988) emphasize that incentive systems can be adapted to align individual goals with those of the organization (yielding incentive structures that would not be optimal in the absence of influence activities). This option is not feasible in our experiment.

probability and remains uninformed otherwise. Irrespective of the availability of the communication technology, sellers can always indicate their cost level to the buyer (by sending a structured message), but the buyer cannot verify this signal (cheap-talk). In the no communication treatments buyers and sellers have no way to communicate with each other. In the communication treatments the trading parties have access to a costless, free-form communication technology. The technology allows to contact (potential) trading partners and to exchange chat messages. Importantly, trading parties can refuse to communicate by either rejecting or not answering a partner's attempt to communicate.

Our main results in the symmetric information treatments can be summarized as follows: Without communication we replicate the results of Fehr et al. (2011) and find that buyers face a trade-off between contractual rigidity and flexibility. Flexible contracts have the advantage that they guarantee trade irrespective of the seller's cost. Since buyers observe the cost ex post, they can simply increase the price to cover the seller's cost if it turns out to be high. The downside of flexibility is that sellers tend to provide low quality if they do not obtain a sufficient share of the surplus if the cost is low. Rigid contracts, in contrast, allow to reduce these conflicts in the low-cost state. Since the price is competitively determined ex ante and cannot be adjusted ex post, sellers seem to be more willing to accept payoff inequality and the inefficient provision of low quality is much less frequent than in flexible contracts. The disadvantage of rigidity is that trade is not feasible in the high-cost state.

The availability of the costless, free-form communication technology has two main implications for contractual outcomes. First, we observe a pronounced price increase in flexible contracts in the low-cost state. An analysis of the content of exchanged messages suggests that this is a consequence of the fact that sellers mostly use the communication technology for influence activities. In particular, they try to convince buyers to pick flexible contracts and to pay high prices. Second, the conflict potential in flexible contracts further increases in the presence of the communication technology. The reason is that sellers are even more prone to pick low quality if buyers decide to pay low prices in the low-cost state. A possible explanation is that that sellers may be especially disappointed if their share of surplus is small after they have tried (and failed) to convince the buyer to be generous. The same mechanism may also explain the fact that conflicts also become somewhat more frequent in rigid contracts (but to a smaller degree than in flexible contracts). As a consequence of the dominance of influence activities when communication is used, it turns out that conflicts are least frequent and buyer profits (and surplus) are highest if the buyer picks a rigid contract and does not communicate with the seller.

The outcome pattern observed in our treatments with asymmetric information about the cost of the seller is similar to the one in the symmetric information treatments. In the absence of common knowledge about the cost level many sellers try to use the free-form communication channel to convince the buyer that their cost is high. Because the information content of these messages tends to be rather low (many sellers do not reveal their cost level truthfully), buyers often reject to communicate from the outset. As a consequence, communication does not fundamentally change contractual outcomes. The trade-off between contractual rigidity and flexibility remains fully intact when the communication technology is available.

Our study complements the existing literature in that it shows that the impact of free-form communication on cooperation and conflict crucially depends on the details of the environment. The previous literature has mostly focused on the positive effects of communication in strategic non-market settings such as social dilemmas. Our paper, in contrast, studies a contracting environment in which competition leads to considerable payoff inequality. We find that in such a setting free-form communication has no efficiency-enhancing effect. Interestingly, there is a parallel literature showing that free-form communication may also have detrimental effects in competitive coordination games (Cason et al. 2012, 2017 and Leibbrandt and Sääksvuori 2012). However, the reasons for the ineffectiveness of communication in their setups and ours are quite different. In competitive coordination games free-form communication leads to better within-group coordination, but because the groups compete much more aggressively overall efficiency goes down. In our competitive contracting setting, in contrast, the communication technology is predominantly used for influence activities through which sellers try to obtain a larger share of the surplus. These influence activities further increase the potential for conflicts, because sellers who fail to influence buyers respond more harshly to low prices. As a consequence, buyers minimize conflicts and maximize profits if they choose rigid contracts and refuse to communicate. Thus, although communication seems to have powerful, efficiency-enhancing effects in many environments, there are also settings in which communication remains ineffective so that contractual solutions may be needed to improve outcomes.

The remainder of the paper is structured as follows: Section II discusses the related literature. Section III presents the experiment design and procedures. Section IV derives predictions and hypotheses. Section V presents the results. Section VI, finally, concludes.

II. Experimental Design

We present the market set-up 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 Set-up and Parameters

Buyers and sellers interact in groups of four. These groups are reconstituted at the beginning of each period. The matching procedure guarantees that participants meet each other only once during the experiment (i.e., we apply a perfect stranger matching protocol). Each group consists of two buyers and two sellers. Sellers have the capacity to produce up to two units of a product that they can sell to the buyers. However, because each buyer can at most buy one single unit per period, supply is twice as large as demand and so the sellers need to compete for buyers. The market is set up such that buyers offer contracts for which sellers compete in an auction. Contracts represent agreement to trade, but trade is voluntary and only occurs if the contract allows for terms that guarantee non-negative profits for both parties involved. If a transaction is carried out the buyer's profit is equal to his valuation for the product v minus the price p. The profit of the seller is given by the difference between the price p and the production cost c. The seller's production cost is stochastic and unknown to the parties at the time of contracting. There are two states of nature (σ): 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 quality of the traded product is not perfectly contractible. Sellers therefore have the possibility to modify—at a small cost—the quality q of the product in a way that reduces the buyer's valuation.

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 delivering their product sellers can reduce the quality of the product from normal ($q = q^n$) to low ($q = q^l$). Doing so slightly increases their production cost: $c(q^l, \sigma) - c(q^n, \sigma) = 5$. Quality reductions should be thought of as hostile acts that the seller can undertake to hurt the buyer: $v(q^n) - v(^lq) = 40$. Hart and Moore (2008) term this type of

behavior as "shading".[3] When a contract does not allow for a mutually beneficial trade, both the seller and buyer realize an outside option of 10 points ($x_S = x_B = 10$). When a seller is not able to sell one or both his units of the product, because the other seller won the contract auction, the seller also receives the same outside option for each product that has not been traded. Table 1 summarizes the cost and value parameters of the experiment.

II.B. Interaction of Buyers and Sellers Within a Period

The following interaction steps between buyers and sellers all common to all our treatments. In some of our treatments there are additional features that are added to these steps. We describe these details in the next section when we discuss the different treatments implemented in the experiment.

Random formation of interaction groups:

> In every period groups consisting of two buyers and two sellers are formed. The matching procedure ensures that participants meet only once during the experiment.[4]

Phase 1: Ex ante contracting:

> *Step 1: Buyers' contract choice*
>
> At the beginning of a new period each buyer chooses a contract type (t). The buyer chooses between 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.

[3] For simplicity, Hart and Moore (2008) assume that shading has no consequence for the profit of the party that engages in the activity (i.e., parties are indifferent between the different levels of performance that they can provide). We introduce costly sabotage to rule out equilibrium sabotage under standard economic assumptions. Thus, in our setup the quality choice of the seller essentially corresponds to a punishment decision (see e.g. Fehr and Gaechter 2000).

[4] The perfect stranger matching protocol is important in this experiment, because some of our treatments involve free-form communication. In those treatments it is possible that particularities in the writing style of certain participants makes them recognizable for other participants so that reputation effects might enter the game. Such reputation effects would confound treatment comparisons. The perfect stranger protocol eliminates this issue.

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 determined within each group. If a rigid contract is auctioned off the auction directly determines the fixed price $p^r \in [c(q^l,g) + x_S, 75] = [35, 75]$.[5] 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 seller's maximal production cost in the bad state of nature: $p^u = c(q^l,b) + x_S = 95$. 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 accepting 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 directly realizes the outside option x_S (i.e., there is an outside option for each of the two auctions).

Determination of the state of the world:

After the contract auctions the computer randomly determines the state of the world for each contract independently.

Phase 2: Ex post trading:

Step 3: Buyers' choice of contract terms

Once the state has been determined, the buyer determines the final terms of the contract. How much flexibility he has in doing this depends on 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 the price covers the cost: a seller cannot refuse to trade if the price covers the 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 ($p^r \in [c(q^l,g) + x_S, 75] < c(q^n,b) = 80 < c(q^l,b) = 85$). In the latter case trade is not feasible and both trading parties realize their outside

[5] 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.

options. If the contract allows for trade the buyer either pays the fixed price (rigid contract) or picks a price out of the available price range (flexible contract).[6]

Step 4: Sellers' 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 aggregated information about the market outcome.[7]

Subsequently, a new period begins and participants are randomly reassigned to new groups.

II.C. Experimental Treatments

In the following, we describe the four treatment conditions that we implemented in this experiment. We vary two dimensions independently: the information environment (symmetric vs. asymmetric information) and the availability of a communication technology.

The Information Environment

In the symmetric information treatments (Sym) the state of the world is common knowledge. Both the seller and buyer learn whether the production cost is high or low before the buyer makes his final price choice. In the asymmetric information treatments (Asym) only the seller gets to know cost level with certainty. The buyer, in contrast, receives this information only in 20 percent of the cases (randomly determined). The seller observes whether the buyer is

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[6] In the bad state the buyer's price needs to ensure that the seller cannot make losses relative to his outside option even if he provides low quality: $p \geq c(q^l,b) + x_S$. At the same time the upper blound of the price range is equal to exactly this threshold price: $p^u = c(q^l,b) + x_S$. The buyer can therefore only pick one price in the bad state of the flexible contract: $p = c(q^l,b) + x_S = 95$. This upper bound implies that the flexible contract exhibits the minimal flexibility that guarantees trade in both states while making sure that the seller cannot 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 5).

[7] 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 set-up allows for many possible constellations (two contract types, two states of nature, two quality levels, many prices), learning from individual experience is rather difficult.

informed or not. Irrespective of the availability of the communication technology sellers always have the possibility to send a non-verifiable signal to uninformed buyers. The message through which the signal is delivered is completely standardized and cannot be modified. The seller can only determine whether the message indicates a high or a low cost level.

In rigid contracts this type of asymmetric information is without consequence. Recall that trade only occurs in our setup when both parties make a non-negative profit. Since prices in rigid contracts are always below the high cost level, trade is never feasible in this state. In flexible contracts, however, the information asymmetry matters. Sellers have no material incentive to reveal the true cost level, because their profit is always higher if the buyer believes that the cost is high and pays a high price.[8] If the buyer has no credible information about the cost level the parameters of the experiment make it financially optimal to offer a price below the high cost level.[9] This, however, implies that if uninformed buyers maximize their profits, trade will not be feasible in the high-cost state.

The communication technology:

In our no communication treatments the trading parties have no way to communicate with each other, except for the standardized signal that sellers can send to uninformed buyers in the asymmetric information environment. In the communication treatments instead participants have access to a costless, free-form communication technology that allows them to contact potential and actual trading partners during the game. The communication technology essentially works like a telephone. Participants can call other participants, calls can be accepted or rejected, and calls can be ended at any point in time. If a communication channel has been established, the communication partners can exchange free-form text messages with each other. Each participants has two separate communication lines so that each potential trading partner can be contacted. Conversations with both potential trading partners can take place simultaneously. The overall communication time with a particular partner during a

[8] There may be psychological reasons for the buyer to signal his or her cost honestly. Experimental evidence indicates that for many people lies that potentially hurt others are associated with a psychological cost (see e.g. Gneezy 2005 or Gneezy et al. 2013).

[9] Take the following extreme case: The buyer believes that if he pays a price of 35 (the competitive price), the seller will shade with certainty. If he picks a price of 95 instead the seller will never shade irrespective of the cost level. This yields the following expected payoffs: $E\pi_B(p = 35) = 0.8(100 - 35) = 52$ and $E\pi_B(p = 95) = 45$. Depending on how the seller adapts his shading behavior to prices above 35, there may be other prices (lower than 95) that further increase the buyer's payoff, but it is never optimal to pay the highest possible price of 95.

period is limited to 120 seconds. Conversation among players of the same type are never possible.

The communication technology is available in three important phases of the interaction between sellers and buyers. First, communication is available before and during the contract choice of the buyer. In this phase each participants can contact both potential trading partners. Second, communication is again possible before the buyers choose the final price (i.e. after contracts have been auctioned off). Third, there is a final communication phase before the seller chooses the quality level (i.e. after final prices have been determined). In the second and third phase communication is only possible with the actual trading partner.

Figure 1 shows the layout of the communication technology as displayed on participants' screens. The communication boxes were constantly visible and were located to the right of the decision part of the screens.

Crossing our two variations yields a two-by-two design with the following four conditions: symmetric information without communication (NoComm-Sym), symmetric information with communication (Comm-Sym), asymmetric information without communication (NoComm-Asym), asymmetric information with communication (Comm-Asym) Table 2 provides a summary of our treatment conditions. Figure 2 provides a timeline and shows the elements that each condition adds.

II.D. Subjects, Payments and Procedures

All subjects were students of the University of Zurich or the Swiss Federal Institute of Technology Zurich (ETH). We used the recruitment system XXX. 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. The experiment was programmed and conducted with z-Tree (Fischbacher 2007).

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 was 10 Points = 1 Swiss Franc.

In order to make the sellers familiar with the auction procedure we implemented trial auctions 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 data used in this paper was collected in two waves. The first 13 sessions were run in November and December 2016. The second 11 sessions were conducted in May and June 2017. The four treatments were randomly allocated to sessions.

We recruited 32 participants for every session. In all the 24 sessions together we therefore had a total of 768 participants. A session lasted about 135 minutes and subjects earned on average about 52 Swiss Francs (including a show-up fee of 10 Swiss Francs).

III. Behavioral Predictions

In this section we establish a set of testable hypotheses for our experiment. In section **Error! Reference source not found.** we analyze our game from the perspective of the standard self-interest model. While we do not expect that the data will support these predictions, they provide a useful benchmark and help to clarify some features of our experiment. In section **Error! Reference source not found.** we illustrate how contractual reference points (Hart and Moore 2008) shape the predictions in the absence of communication. The following two sections present alternative and contradicting predictions for the effects of communication in the presence of contractual reference points. Section **Error! Reference source not found.** adopts a positive view and assumes that communication helps with ex-ante expectations management and ex-post damage control. Section **Error! Reference source not found.** presents a more negative view according to which communication will be abused for influencing activities.

III.A. Self-Interest Model

The prediction of the self-interest model is simple. Buyers anticipate that selfish sellers are never willing to engage in costly shading. 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 $p^l = 35$.[10] Under symmetric information buyers can always distinguish the states of the world. As a consequence, they simply pay the lowest price that

[10] Remember: Since $p = 35$ corresponds to $p = c(q^l,g) + x_S$ and trade in the bad state is feasible only if the buyer offers $p = p^u = 95$, a seller can never be worse off if he accepts a contract than if he accepts his outside option.

guarantees trade (if the contract includes such price). In the good state the price therefore corresponds to $p = 35$ in both types of contracts. The resulting buyer payoff amounts to: $\pi_B = v(q^n) - p = 140 - 35 = 105$. In the bad state trade is only feasible in flexible contracts ($p = 95$ and $\pi_B = v(q^n) - p = 140 - 95 = 45$), while the rigid contract simply yields the outside option ($\pi_B = x_B = 10$). Buyers are therefore better off by picking the flexible contract.

Under asymmetric information the situation is similar. The outcomes of rigid contracts remain the same. In flexible contracts the difficulty for the buyer is that with probability 0.8 the two states of the world cannot be told apart. Sellers never have an incentive to truthfully signal the good state. Buyers can therefore either offer a high price that guarantees trade ($p = 95$), or a low price ($p = 35$) that entails a risk that trade is infeasible. The parameters of the experiment imply that the latter choice is optimal.[11] As a consequence, the only difference to the case with symmetric information is that the flexible contract no longer guarantees trade in the bad state. However, since trade still occurs with a positive probability in the high-cost state, buyers still strictly prefer the flexible contract.

The presence of a communication technology does not affect these predictions, because all messages sent are cheap talk.

III.B. Contracts as Reference Points

In this section we explore the implications of the notion that ex ante contracts provide reference points for ex post trade. We build on a slightly adapted version of the Hart-Moore model (see also FHZ 2011). We define the reference price $p^R(t, \sigma)$ as the price the seller feels entitled to, given the contract type t and the realized state of nature σ. We assume that the seller's reference price p^R can be any price permitted by the terms of the contract in a given state σ. In flexible contracts the reference prices therefore satisfy: $p^R(f, g) \in [p^l, p^u]$ and $p^R(f, b) = p^u$. In rigid contracts the reference price is only relevant in the good state: $p^R(r, g) = p^r$. The reference price enters the sellers utility function as follows:

$$(1) \qquad u_S = \pi_S - \theta \max[(p^R(t, \sigma) - p), 0]\, I(q),$$

where $\theta \geq 0$ and $I(q)$ is an indicator function, which is unity if $q = q^n$ and zero otherwise. The second term captures the seller's utility loss (aggrievement), if the realized price p is smaller

[11] Offering the high price ($p = 95$) yields the following expected buyer profit: $E\pi_B = v(q^n) - p = 140 - 95 = 45$. Offering the low price ($p = 35$) yields: $E\pi_B = 0.8(v(q^n) - p) + 0.2x_B = 0.8(140 - 35) + 2 = 86$.

than the seller's reference price p^R. The parameter θ measures the intensity of the aggrievement that the seller experiences in case of a deviation from his reference price. The indicator function $I(q)$ implies that the seller can completely offset his aggrievement by shading on performance.

In rigid contracts aggrievement does not occur. The only price available is the fixed price (which is also the reference price), so that deviations from the reference point are impossible. Sellers have therefore no reason to engage in shading. The same logic applies in flexible contracts when the bad state of the world is realized. The only price available to the seller is $p = p^u$. This is also the seller's reference point. So, no shading should occur. In the good state, in contrast, realized prices in flexible contracts may differ from reference prices and aggrievement and shading become a possibility. A seller is only willing to offer normal quality if the buyer pays a price that is equal or above the following threshold price p^T:

(2) $\quad p^T = p^R(f, g) - [c(q^l, g) - c(q^n, g) / \theta]$.

There may be heterogeneity with regard to both reference prices p^R and aggrievement intensities θ, so that threshold prices p^T may differ across sellers. Let $F(\cdot)$ be the distribution function of threshold prices in flexible contracts when the state is good. A buyer with a flexible contract who observes that the state of the world is good offers the following price:

(3) $\quad p^f_g = \arg\max v(q^n)F(p) + v(q^l)[1 - F(p)] - p$.

If a buyer with a flexible contract cannot observe the state, he would also offer the price p^f_g.[12]

This leads to the following expected profits for the different contract choices:

Rigid contract yield the following expected profit irrespective of the information condition:

(4) $\quad E\pi_B^r = w^g[v(q^n) - p^r] + (1 - w^g)x^B$.

The buyer's expected profit in flexible contracts depends on the information environment. Under symmetric information the expected profit is:

(5) $\quad E\pi_B^f{}_{SYM} = w^g[v(q^n)F(p^f_g) + v(q^l)(1 - F(p^f_g)) - p^f_g] + (1 - w^g)[v(q^n) - p^u]$.

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[12] This follows from the parameters of the experiment: Assume that an uninformed buyer offers the competitive price of $p = 35$. In the worst case this would motivate all sellers to engage in shading. With this offer trade would occur with probability 0.8 and the trade profit of the buyer would amount to $\pi_B = 100 - 35 = 65$. In expectations this yields $E\pi_B = 52$. This is higher than the profit that the buyer can obtain from offering the price that guarantees trade $p = 95$. In this case his profit would amount to $\pi_B = 140 - 95 = 45$. In general, the optimal price p^f_g will be different from 35, but if this is the case, the expected profit from paying $p = p^f_g$ will never be less than 65 (otherwise the price wouldn't be optimal).

Under asymmetric information the expected profit is:

(6) $\mathrm{E}\pi_B{}^f{}_{ASYM} = 0.2\ \mathrm{E}\pi_B{}^f{}_{SYM} + 0.8\ w^g[v(q^n)F(p^f{}_g) + \mathrm{v}(q^l)(1 - F(p^f{}_g)) - p^f{}_g]$.

Whether the buyer's profit maximizing contract is rigid or flexible depends on the importance of the shading problem in flexible contracts. Intuitively, the more costly it is for buyers to reduce the shading rate in flexible contracts, the more attractive rigid contracts become. 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.

III.C. Effective Communication: Expectations Management and Damage Control

Previous work has demonstrated that communication can increase efficiency by reducing conflicts in certain environments (see e.g. Xiao and Houser 2005, Andersson et al. 2010, Fehr et al. 2015, Brandts et al. 2016). In our setup there are mainly two channels through which communication can help: ex-ante expectations management and ex-post damage control. We discuss them one after the other.

The idea behind ex-ante expectations management is that buyers use the communication technology to influence the seller reference price. According to Hart and Moore (2008) shading activities are triggered if a shading party feels shortchanged because the obtained share of the surplus is lower than what the party feels entitled to. Thus, if buyers succeed in lowering sellers' expectations through communication, conflicts should become less frequent. Fehr et al. (2015) provide evidence that lends some support to this hypothesis. Their design allows buyers to add structured (state-contingent) price announcement to flexible contracts before the contracts are auctioned off to the sellers. They find that such price announcements reduce the shading rate to some extent. Thus, if buyers make use of the free-form technology to make the sellers aware of their price setting plans before the sellers accept the contract they might be able to mitigate the shading problem in flexible contracts.

We propose a straightforward way to embed the idea of expectations management in the model. Let p^A be an unbinding (cheap talk) price announcement through which the buyer informs the seller about his price setting plan in flexible contracts if the good state of the

world occurs.[13] Assume that the price announcement shapes the seller's reference price as follows:

(7) $p^R(f, g, p^A) = \alpha\, p^A + (1 - \alpha)\, p^R(f, g)$, where $\alpha \in [0, 1]$.

The new reference price is a weighted average of the buyer's price announcement and the seller's reference price that he would have had in the absence of a price announcement. The higher the weight of the announcement α, the more successful is the buyer's attempt to manage the seller's ex-ante expectations. If α is positive buyers can use low price announcements to reduce the seller's inclination to engage in shading. Specifically, profit-maximization implies that buyers who choose a flexible contract should combine the contract with a price announcement that informs the seller that the buyer always plans to pay the lowest price possible: $p^A = p^l$. Such a price announcement shifts the distribution of sellers' threshold prices to the left and therewith increases the profitability of flexible contracts. In the extreme case where $\alpha = 1$, price announcements would actually allow the parties to reach the first-best outcome.

Ex-post damage control refers to the idea that buyers may not only use communication to shift reference points ex ante, but also to reduce the intensity of aggrievement that the seller experiences once a realized outcome violates the seller's feelings of entitlement. The idea is that buyers justify the price choices that have been made (e.g. by arguing that buyers are entitled to a large share of the surplus, because they are on the short side of the market) or convince sellers that starting a conflict is inappropriate (e.g. by emphasizing that shading not only reduced the buyer's profit, but also has negative consequences for the seller). There is evidence that proper justification can indeed reduce the negative reactions to seemingly "unfair" outcomes. Using field data Greenberg (1990), for example, finds that an adequate explanation of a wage cut triggers less counterproductive behavior (employee theft) than the same wage cut with an inadequate explanation.

In our setup a price justification p^J might have a direct impact on the seller's aggrievement intensity: if the buyers succeed in justifying their price choices appropriately, the same deviation from the reference price triggers less aggrievement: $\theta(p^J) < \theta$. Successful ex-post damage control would also shift the distribution of threshold prices to the left and

[13] In Fehr et al. (2015) buyers made state-contingent price announcements, because flexible contracts also allowed for a range of prices in the bad state. In our experiment buyer have no price setting discretion in the bad state, so that price announcement are not necessary for this contingency.

increase the profitability of flexible contracts. In the extreme case where $\theta(p^J) = 0$, flexible contracts would again yield the first-best outcome.

If literally interpreted, our model predicts that the choice of a rigid contract should not trigger any shading. However, while existing evidence confirms that rigid contracts reduce the shading rate significantly (see Fehr et al. 2011, 2015, Brandts et al. 2016, Erlei and Reinhold 2016), the shading rate is never zero. Ex post damage control might therefore also have a positive effect in rigid contracts, because it might allow buyers to decrease the shading rate even further (but the potential for improvement is smaller than in flexible contracts). The same logic also applies for outcomes in flexible contracts when the bad state of nature is realized.

We summarize the implications of these considerations as the

Effective Communication Hypothesis:

i. Use of communication (when available)
   - Communication is used frequently throughout the experiment.
   - Ex-ante communication: Before contract conclusion, buyers use communication to inform the sellers about their price setting plans in the flexible contract they are about to offer.
   - Ex-post communication: During the trading phase buyers use communication to justify their previous decisions and to convince the seller not to enter into conflict.

ii. Outcomes in contracts and contract choice
   - Flexible contracts: In the good state of nature sellers' tendency to engage in shading when buyers offers a low price should decrease when communication is available. In response buyers are expected to offer lower prices and/or the shading rate should go down. In the bad state of the world the presence of communication opportunities might further reduce the shading rate. As a consequence, the availability of communication makes flexible contracts more profitable for buyers (and possibly more efficient).
   - Rigid contracts: To the extent that this is possible, communication should help to further reduce the shading rate in rigid contracts (but the potential for improvement is expected to be small relative to the one in flexible contracts).
   - Contract choice: Buyers will choose flexible contracts more frequently when communication is available.

III.D. Ineffective Communication: Influence Activities

The previous section has emphasized that the buyer might be able to use communication to influence the seller to act more in the interest of the buyer. In this section we turn this discussion on its head and analyze how sellers might be tempted to use communication to change the behavior of the buyer in ways that favors sellers. While in our setup both players make choices that affect the size of the overall surplus (buyers pick contract types, sellers pick quality), the distribution of the surplus is predominantly determined by the decisions of the buyer.[14] Both the contract choice and the price choice in flexible contracts have a decisive impact on the share of surplus that the seller obtains. The literature on influence activities suggests that parties might use communication to influence choices of others who have discretion over decisions with distributional implications (see e.g. Milgrom 1988, Milgrom and Roberts 1988, Meyer et al. 1992). Applied to our setup this means that sellers might try to use communication to present private information such that the buyer's contract choice and price setting behavior are influenced to their advantage.

In our symmetric information treatments there is no informational asymmetry with regard to the objective parameters of the trading situation. However, sellers obviously have private information about their threshold price p^T (our model assumes that the buyer knows the distribution of threshold prices $F(\cdot)$, but not the individual threshold price of sellers). Sellers have the best chance to get a high profit if the buyer chooses a flexible contract and picks a high price. With communication sellers can try to convince buyers to move in this direction (through persuasion, promises, threats etc.). One might argue that buyers should simply ignore such influencing activities and not respond to them. However, this is only optimal if the engagement in influencing activities does not affect the seller's behavior. It is easy to come up with reason for why this might not be the case. When asking for flexible contracts and insisting on high prices in the conversation with the buyer, the seller might indeed start to feel entitled to such an outcome. Thus, influencing activities might affect the reference price: $p^R(I) > p^R$, where I stands for influence activities. Likewise, after explicitly expressing that low prices would lead to disappointment, the seller might be particularly upset

[14] One can argue that in rigid contracts it is the sellers who determine the division of the surplus by picking the price in the auction. In reality, however, sellers have not much discretion over the price in this situation, because they need to pick the price in a highly competitive environment. It is the buyer who decides whether the price is determined competitively among the sellers or unilaterally by the buyer.

if the buyer ignores his demand: $\theta(I) > \theta$. These two effects imply that influencing activities might increase the threshold price: $p^T(I) > p^T$.

In the environment with asymmetric information the same mechanisms apply, but in addition, there is also the element that the buyer may not know the seller's cost. If the buyer is not informed about the cost, influencing activities may become even more important. By arguing that their cost is high, sellers can now aim for threshold prices that are not feasible under symmetric information.[15] In particular, if they succeed in convincing the buyer that their cost is high, the buyer will pay the price $p = p^u$ to make trade possible. As argued above, it is possible that the engagement is such activities increases the potential for conflicts, because the sellers' feelings of entitlement are affected by the influencing activities.

Influence activities may make flexible contracts less profitable for buyers, because they may either need to pay higher prices or accept a higher shading rate. Milgrom and Roberts (1988) argue that there are three measures that can be taken to reduce influence activities: First, communication channels can be closed. Second, decision makers' discretion can be limited to restrict their ability to respond to influence activities. Third, incentive systems can be adapted to align individual goals with those of the organization. In our experiment the third option is not feasible, but the other two possibilities are relevant. Buyers can reject communication attempts of sellers (either by clicking the reject button or by simply not clicking the accept button in the chat interface). In addition, buyers can also commit not to respond the influence activities by immediately picking a rigid contract at the beginning of the period.

Taken together these arguments lead to the

Ineffective Communication Hypothesis:

i. Use of communication (when available)
   - Sellers will try to initiate communication, but buyers will often refuse it.
   - Ex-ante communication: Sellers use communication to convince the buyer to pick a flexible contract and to follow up with high prices.
   - Ex-post communication: Sellers use communication to convince buyer to offer high prices.

[15] Under symmetric information it is never profit-maximizing to pay more than $p = p^l + 40$ (higher prices are dominated by the choice to pay the lowest price possible, even if this implies that the seller shades with certainty). Thus, if competition drives down p^l to 35, the highest price that the seller can aim for is 75. Under asymmetric information, in contrast, the seller can push for 95, because this is the price necessary to allow for trade in the bad state.

ii. Outcomes in contracts and contract choice

- Flexible contracts: In the good state of nature sellers' tendency to engage in shading when the buyer offers a low price should increase when communication is used. In response buyers either offer higher prices and/or the shading rate goes up. In the bad state of the world communication opportunities have no impact on outcomes. As a consequence, the availability of communication makes flexible contracts less profitable for buyers (and possibly less efficient).
- Rigid contracts: If sellers ask for flexible contracts in ex-ante communication, the choice of a rigid contract might trigger more shading (but the impact is expected to be smaller than in flexible contracts).
- Contract choice: Buyers will choose rigid contracts more frequently when communication is available.

IV. Results

In this section we present our results. We first discuss the results that we obtain in the environment with symmetric information. In section **Error! Reference source not found.** we show how the availability of a free-form communication technology affects outcomes in rigid and flexible contracts. We find that the observed pattern is largely in line with the ineffective communication hypothesis. In section IV.A we provide further support for the ineffective communication hypothesis by illustrating that also the frequency with which communication is used and the content of the exchanged messages is in line with our interpretation. Finally, section **Error! Reference source not found.** discusses how asymmetric information about the cost affects outcomes.

IV.A. Outcomes in Rigid and Flexible Contracts under Symmetric Information

Table 3 provides an overview of the main outcomes in rigid and flexible contracts in the two treatments with symmetric information (NoComm-Sym and Comm-Sym). The displayed variables include averages of prices, shading rates, contract realization rates, profits, surplus and contract choice. Tables 4 and 5 contain the corresponding regression analyses.

Before we turn to the analysis of the impact of communication in our setup, we first focus on the outcomes in the no communication treatment with symmetric information (NoComm-Sym). It is important to establish that the findings in this treatment are in line with

the behavioral predictions established in section III.B and replicates the earlier established finding that buyers face an important trade-off when choosing their contract type (see Fehr et al. 2011, 2015). In the symmetric information treatments flexible contracts have the advantage that they guarantee trade in both states of the world. Moreover, the contract is designed such that it only has the minimal flexibility necessary to allow for trade in the bad state. As a consequence, the buyer has no discretion in setting prices when the seller's cost are high (the only possible price is $p = 95$). According to theory, the fact that there is no room for disagreement about prices should imply that conflicts are rare. Our data confirm this prediction. Buyers who pick flexible contracts and end up in the high-cost state experience a low shading rate (0.06) and are able to make profits that considerably exceed their outside option (average profits amount to 42.4, while the outside option is $x_B = 10$).

Theory predicts that the upside of rigid contracts, in contrast, is that they allow for smoother trade than flexible contracts in the good state of the world. The reason is that the competitively determined fixed price in rigid contracts should align expectations, while the price range in flexible contracts provides room for disagreement and conflicts. Indeed, our data reveals that although prices are lower in rigid contracts (44.5 (rigid) vs. 48.3 (flexible)), the shading rate in rigid contracts is less than half of what it is in flexible contracts (0.10 (rigid) vs. 0.22 (flexible)). Buyers with a rigid contract therefore realize a profit of 91.6 in the good state, while buyers with flexible contracts only make a profit of 82.8. The regressions in Tables 4 and 5 test for the statistical significance of these differences. In column (3) of Table 4 we regress prices in the good state of the world on treatment dummies, an indicator variable for flexible contracts and their interaction terms with the treatment dummies (the omitted category captured by the constant is rigid contracts in the NoComm-Sym treatment). The significant coefficient for the indicator variable for flexible contract shows that the price difference is significant ($p = 0.005$).[16] Column (6) contains the corresponding estimation for the shading rate. In this estimation we also control for prices. The regression shows that also the difference in shading rates is significant ($p < 0.001$). The significance of the difference in buyer profits in the good state can be seen in Column (3) of Table 5

[16] All regressions are using the data of all four treatments. This means that the regressions in **Error! Reference source not found.** and

Table also contain the data from treatments with asymmetric information. The reason for running the regressions in this way is that we need to adjust standard errors for clustering at the session level. Participants are matched with different trading partners in every period, so that observations within a session cannot be treated as independent. Using all data in the estimations provides us with a larger number of clusters. We will interpret the coefficients that relate to the environment with asymmetric information when discussing these results in section **Error! Reference source not found.**

Table (the specification is the same as the one that we used for prices, $p < 0.001$).

Because the good state of the world occurs more frequently (probability 0.8), the advantage of the rigid contract in the good state fully outweighs the advantage of flexible contracts in the bad state and rigid contracts are overall more profitable for buyers (77.5 (rigid) vs. 73.8 (flexible)). However, this difference is not statistically significant ($p = 0.158$, see Column (4) of

Table).[17]

The main interest of this paper is to investigate how the opportunity to engage in free-form communication affects the trade-off between contractual rigidity and flexibility. In sections III.C and III.D we have established two competing hypotheses. The effective communication hypothesis builds on the assumption that communication will predominantly be used by buyers who engage in ex-ante expectations management and ex-post damage control. According to this hypothesis conflicts should become less frequent which would mostly benefit flexible contracts. The ineffective communication hypothesis, in contrast, emphasizes the danger that sellers might try to (ab)use the communication technology for influence activities. This approach predicts that communication might further increase the conflict potential in flexible contracts. As a consequence buyers might reject communication attempts and keep relying on rigid contracts.

In what follows we will test these hypotheses against each other and investigate the accuracy of the different aspects of the two hypotheses. In doing so we will—in a first step—only rely on pure treatment comparisons. This implies that the data from the Comm-Sym treatment will include observations in which the trading parties did not use the communication technology at all. This is important, because observed differences cannot be selection-driven and can be interpreted as the direct, causal effect of endowing trading parties with a costless, free-form communication technology.

Our first result concerns the impact of the availability of the communication technology on the distribution of prices in flexible contracts in which the good state is realized:

Result 1 (Impact of the availability of communication on prices in flexible contracts):
The availability of a costless, free-form communication technology causes a strong increase in prices in flexible contracts when the good state of the world is realized.

Table 3 shows that average prices in flexible contracts in the good state of the world increase from 48.3 (NoComm-Sym) to 61.3 (Comm-Sym). In Column (2) of Table 4 we regress prices in flexible contracts where the good state of the world has been realized on

[17] Overall profits and surplus realized in rigid and flexible contracts strongly depend on the parameters in the experiment. Increasing the frequency with which the bad state is realized or reducing the damage caused by shading would benefit flexible contracts, doing the opposite would favor rigid contracts. As these parameters are rather arbitrary, it is not very important which contract is more profitable (or generates higher surplus) overall. Our paper studies how behavior differs across contract types and how the introduction of behavior affects these differences.

treatment dummies (with NoComm-Sym as the omitted category). The coefficient of *Comm_Sym* shows shows that the price increase is highly significant ($p < 0.001$). Figure 3 shows how the price distribution shifts to the right in Comm-Sym relative to NoComm-Sym. While in NoComm-Sym only 6.8 percent of the prices exceed 60, this is true for 53.0 percent in Comm-Sym. Further analysis reveals that in 14.8 percent of the observations in Comm-Sym the difference between the price paid and the lower bound of the price range is larger than 40. This is interesting, because the maximal loss that the buyer can expect from shading is 40 (if the seller is expected to shade with certainty). These are therefore observations in which the buyer could have increased his profit with certainty by simply paying the lower bound of the price range. Almost all these buyers (96 percent) pay a price of 80 which is the price that equally splits the surplus between the buyer and seller if the seller chooses normal quality. In NoComm-Sym observations with a difference of more than 40 between price and lower bound are almost absent (1.0 percent).

Prices in rigid contracts are also somewhat affected by the availability of the communication technology. Table 3 reveals that prices in rigid contracts (good state) decrease from 44.5 to 41.0. Column (1) of Table 4 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: Treatment Conditions

	Symmetric Information	Asymmetric Information
No Communication	NoComm-Sym	NoComm-Asym
Communication	Comm-Sym	Comm-Asym

Table 3: Impact of Communication on Outcomes under Symmetric Information

	No Communication				Communication			
Contract	Rigid		Flexible		Rigid		Flexible	
State	Good	Bad	Good	Bad	Good	Bad	Good	Bad
Price	44.5	-	48.3	95.0	41.0	-	61.3	95.0
Shading	0.10	-	0.22	0.06	0.17	-	0.17	0.03
Auction Outcome	44.4		42.3		41.4		36.7	
Realized	1.00	0.00	1.00	1.00	1.00	0.00	1.00	1.00
Profit Buyer	91.6	10.0	82.8	42.4	92.3	10.0	71.9	43.8
	77.5		73.8		79.8		67.1	
	74.8				70.3			
Profit Seller	24.0	10.0	27.1	14.7	20.2	10.0	40.5	14.8
	21.6		24.3		18.7		36.1	
	23.6				31.8			
Surplus	115.7	20.0	110.0	57.1	112.5	20.0	112.4	58.6
	99.1		98.1		98.5		103.3	
	98.4				102.1			
Contract Choice	0.28		0.72		0.25		0.75	

Notes: The table summarizes the main outcomes in rigid and flexible contracts in the two treatments with symmetric information (NoComm-Sym (left) and Comm-Sym (right)). *Price* is the average final price paid by the buyer to the seller. *Shading* is the shading rate (relative frequency with which the sellers pick low quality). *Auction outcome* is the fixed price (rigid contracts) or the lower bound of the price range (flexible contracts) determined in the competitive auction (irrespective of whether trade eventually occurred or not). *Realized* is the frequency with which trade took place. *Profit Buyer* and *Profit Seller* are average profits of the trading parties and *Surplus* is the sum of these payoffs.

Table 4: Regression Analysis – Prices and Shading

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent Variable	Price	Price	Price	Shading	Shading	Shading
Contract	Rigid	Flexible	Both	Rigid	Flexible	Both
State of the world	Good	Good	Good	Good	Good	Good
Comm-Sym	-3.482***	13.072***	-3.482***	0.060**	0.122**	0.060**
	(1.122)	(1.965)	(1.121)	(0.028)	(0.051)	(0.028)
NoComm-Asym	-4.835***	5.312**	-4.835***	-0.033	-0.093	-0.033
	(0.856)	(2.315)	(0.856)	(0.034)	(0.066)	(0.034)
Comm-Asym	-1.530	11.777***	-1.530	-0.023	-0.095	-0.023
	(1.264)	(2.260)	(1.264)	(0.044)	(0.075)	(0.044)
Flexible Contract			3.726***			0.277***
			(1.189)			(0.050)
Flex x Comm-Sym			16.555***			0.062
			(2.658)			(0.040)
Flex x NoComm-Asym			10.147***			-0.060
			(2.136)			(0.063)
Flex x Comm-Asym			13.307***			-0.073
			(2.832)			(0.063)
Price increment				-0.003	-0.013***	-0.003
				(0.002)	(0.001)	(0.002)
Price inc x Asym				0.006*	0.008***	0.006*
				(0.003)	(0.001)	(0.003)
Price inc x Flex						-0.010***
						(0.002)
Price inc x Flex x Asym						0.002
						(0.003)
Constant	44.525***	48.251***	44.525***	0.125***	0.402***	0.125***
	(0.627)	(0.813)	(0.627)	(0.026)	(0.056)	(0.026)
Observations	794	1,680	2,474	794	1,680	2,474
R-squared	0.056	0.096	0.238	0.010	0.133	0.110

Notes: All estimations are OLS estimations. *Comm-Sym*, *NoComm-Asym*, and *Comm-Asym* are treatment dummies (the baseline category is *NoComm-Sym*). *Flexible Contract* is an indicator variable for observations with a flexible contract. *Price increment* is the price paid minus. Standard errors adjusted for clustering at the session level in parantheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 5: Regression Analysis – Profits and Surplus

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Dependent Variable	Profit Buyer	Profit Buyer	Profit Buyer	Profit Buyer	Profit Seller	Profit Seller	Profit Seller	Profit Seller	Surplus
Contract	Rigid	Flexible	Both	Both	Rigid	Flexible	Both	Both	Both
State of the world	Good	Good	Good	Both	Good	Good	Good	Both	Both
Comm-Sym	0.657	-10.906***	0.657	2.277	-3.835***	13.343***	-3.835***	-2.957***	-0.680
	(1.729)	(2.604)	(1.728)	(4.097)	(1.115)	(2.006)	(1.115)	(0.998)	(4.368)
NoComm-Asym	4.495**	-4.798	4.495**	-1.267	-4.877***	5.377**	-4.877***	-4.564***	-5.831
	(1.691)	(2.944)	(1.690)	(3.872)	(0.847)	(2.348)	(0.847)	(0.740)	(4.151)
Comm-Asym	0.435	-9.790***	0.435	0.630	-1.666	12.026***	-1.666	-1.338	-0.708
	(2.464)	(2.989)	(2.463)	(4.009)	(1.217)	(2.304)	(1.217)	(0.926)	(3.914)
Flexible Contract			-8.814***	-3.743			3.090**	2.730**	-1.013
			(1.930)	(2.563)			(1.132)	(1.032)	(2.778)
Flex x Comm-Sym			-11.564***	-8.920**			17.179***	14.735***	5.816
			(2.879)	(3.846)			(2.694)	(2.417)	(4.645)
Flex x NoComm-Asym			-9.292***	-6.020**			10.254***	8.510***	2.491
			(2.293)	(2.752)			(2.226)	(1.843)	(3.351)
Flex x Comm-Asym			-10.225***	-11.367**			13.692***	10.612***	-0.755
			(3.196)	(4.576)			(2.832)	(2.198)	(4.307)
Constant	91.633***	82.819***	91.633***	77.519***	24.045***	27.135***	24.045***	21.617***	99.136***
	(1.009)	(2.353)	(1.008)	(2.942)	(0.675)	(0.682)	(0.674)	(0.608)	(3.254)
Observations	794	1,680	2,474	3,072	794	1,680	2,474	3,072	3,072
R-squared	0.015	0.053	0.196	0.038	0.056	0.092	0.219	0.158	0.008

Notes: All estimations are OLS estimations. *Comm-Sym*, *NoComm-Asym*, and *Comm-Asym* are treatment dummies (the baseline category is *NoComm-Sym*). *Flexible Contract* is an indicator variable for observations with a flexible contract. Standard errors adjusted for clustering at the session level in parantheses. *** p<0.01, ** p<0.05, * p<0.1.

shows that this decrease is significant ($p = 0.005$).[18] The divergent change in prices across contract types increases the differences in prices between rigid and flexible contracts in the good state of the world. The coefficient of *Flex x Comm-Sym* in Column (3) of Table 4 confirms that the increase in the price difference is highly significant ($p < 0.001$).

Our second result establishes how the availability of the communication technology affects the shading behavior of sellers:

Result 2 (Impact of the availability of communication on shading behavior):
At a given price sellers in the low-cost state engage more often in shading when the costless, free-form communication technology is available. The increase in shading behavior is most pronounced in flexible contracts, but it also occurs in rigid contracts to a lower degree.

Column (5) of Table 4 uses data from flexible contracts in which the good state has been realized. We regress an indicator variable for shading on treatment dummies and control for prices.[19] The positive and significant coefficient of *Comm-Sym* in this estimation indicates that at a given price sellers in flexible contracts in the Comm-Sym condition engage significantly more often in shading than sellers in the NoComm-Sym condition ($p = 0.025$).[20]

[18] We did not predict this effect. The price decrease is most likely a spillover effect from the increased competition for flexible contracts in Comm-Sym. Table 3 shows that the lower bound of the price range (auction outcome) decreases quite strongly in Comm-Sym relative to NoComm-Sym. There are two reason for this: on the one hand seller profits in flexible contracts increase in Comm-Sym relative to NoComm-Sym, so that sellers compete more fiercly for flexible contracts. On the other hand, while the lower bound of the price range is strongly positively correlated with actual prices in NoComm-Sym (Spearman's Rho = 0.603), this is not the case in Comm-Sym (Spearman's Rho = - 0.168). Stronger competition for flexible contracts can have a spillover effect on prices in rigid contracts, because all auctions start at the same time and sellers hear the clicking of others while watching the auction price increase.

[19] When controlling for prices we use the variable "price increment": price increment = price – 35. The reason for doing this is that this allows to interpret the constant as the shading rate in rigid contracts in the NoComm-Sym condition at the level of the competitive price of 35. We also interact price increment with an indicator variable for asymmetric information, because the impact of the price on the shading rate may depend on the information environment.

[20] Column (4) of Table 4 presents the same regression for rigid contracts. The estimation reveals that there is also a statistically significant increase in shading for given prices in the good state of rigid contracts ($p = 0.045$), but the effect is much smaller than in flexible contracts. Moreover, the higher shading rate in rigid contracts is compensated by lower prices (see Figure 3: Effect of Granting Access to Communication on the Price Distribution under Symmetric Information

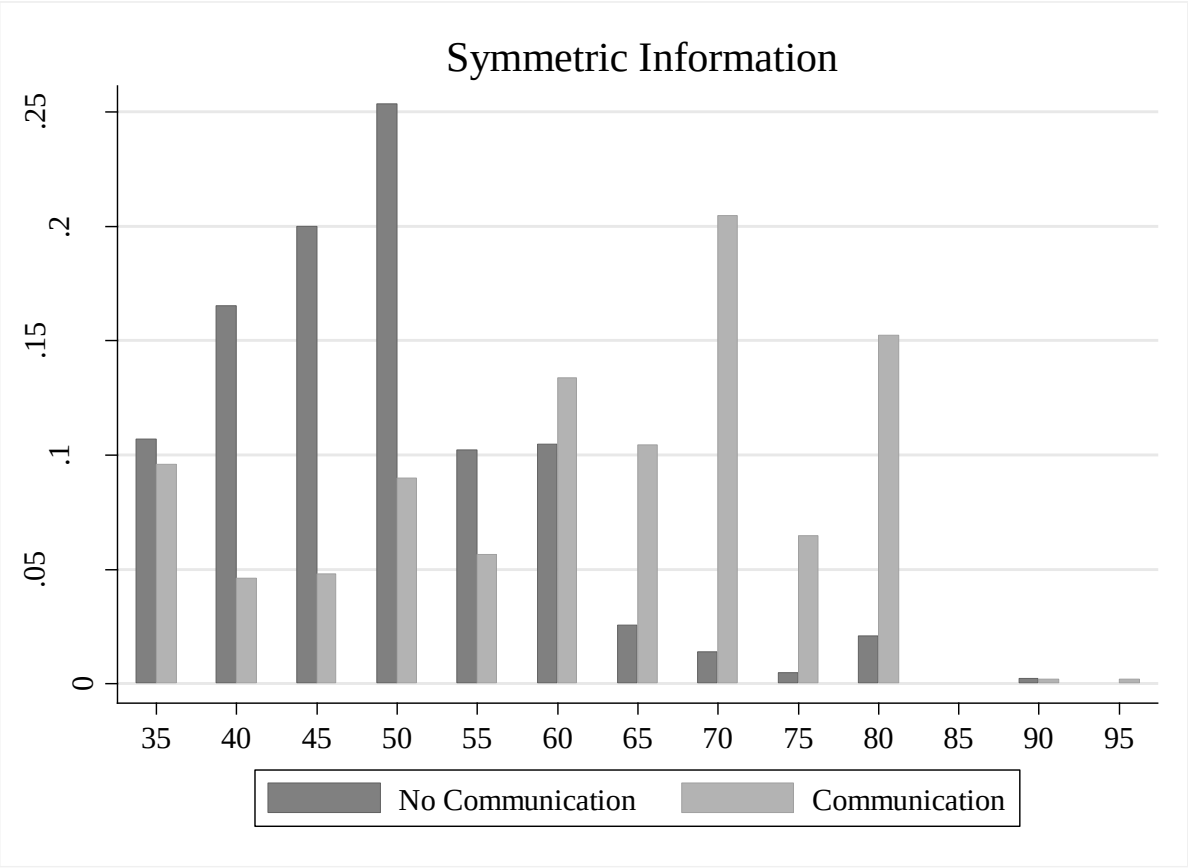


Figure 4: Effect of Granting Access to Communication on Shading Behavior and Prices

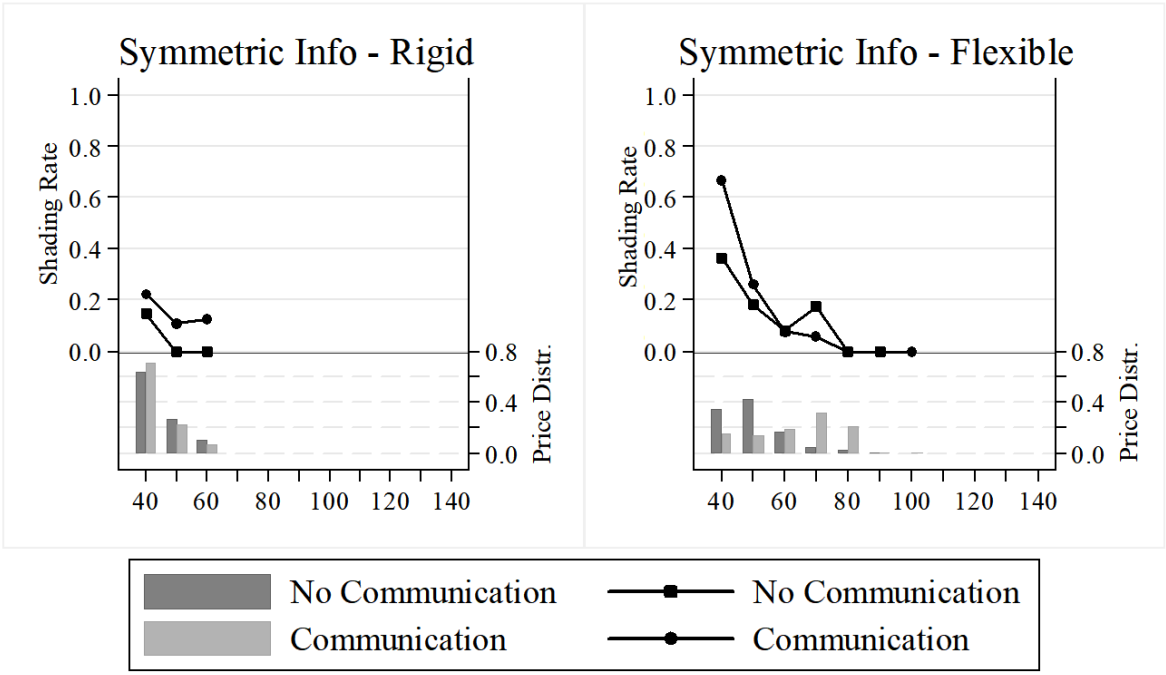


Table 1: Experimental Parameters

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: Treatment Conditions

	Symmetric Information	Asymmetric Information
No Communication	NoComm-Sym	NoComm-Asym
Communication	Comm-Sym	Comm-Asym

Table 3: Impact of Communication on Outcomes under Symmetric Information

	No Communication				Communication			
Contract	Rigid		Flexible		Rigid		Flexible	
State	Good	Bad	Good	Bad	Good	Bad	Good	Bad
Price	44.5	-	48.3	95.0	41.0	-	61.3	95.0
Shading	0.10	-	0.22	0.06	0.17	-	0.17	0.03
Auction Outcome	44.4		42.3		41.4		36.7	
Realized	1.00	0.00	1.00	1.00	1.00	0.00	1.00	1.00
Profit Buyer	91.6	10.0	82.8	42.4	92.3	10.0	71.9	43.8
	77.5		73.8		79.8		67.1	
	74.8				70.3			
Profit Seller	24.0	10.0	27.1	14.7	20.2	10.0	40.5	14.8
	21.6		24.3		18.7		36.1	
	23.6				31.8			
Surplus	115.7	20.0	110.0	57.1	112.5	20.0	112.4	58.6
	99.1		98.1		98.5		103.3	
	98.4				102.1			
Contract Choice	0.28		0.72		0.25		0.75	

Notes: The table summarizes the main outcomes in rigid and flexible contracts in the two treatments with symmetric information (NoComm-Sym (left) and Comm-Sym (right)). *Price* is the average final price paid by the buyer to the seller. *Shading* is the shading rate (relative frequency with which the sellers pick low quality). *Auction outcome* is the fixed price (rigid contracts) or the lower bound of the price range (flexible contracts) determined in the competitive auction (irrespective of whether trade eventually occurred or not). *Realized* is the frequency with which trade took place. *Profit Buyer* and *Profit Seller* are average profits of the trading parties and *Surplus* is the sum of these payoffs.

Table 4: Regression Analysis – Prices and Shading

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent Variable	Price	Price	Price	Shading	Shading	Shading
Contract	Rigid	Flexible	Both	Rigid	Flexible	Both
State of the world	Good	Good	Good	Good	Good	Good
Comm-Sym	-3.482***	13.072***	-3.482***	0.060**	0.122**	0.060**
	(1.122)	(1.965)	(1.121)	(0.028)	(0.051)	(0.028)
NoComm-Asym	-4.835***	5.312**	-4.835***	-0.033	-0.093	-0.033
	(0.856)	(2.315)	(0.856)	(0.034)	(0.066)	(0.034)
Comm-Asym	-1.530	11.777***	-1.530	-0.023	-0.095	-0.023
	(1.264)	(2.260)	(1.264)	(0.044)	(0.075)	(0.044)
Flexible Contract			3.726***			0.277***
			(1.189)			(0.050)
Flex x Comm-Sym			16.555***			0.062
			(2.658)			(0.040)
Flex x NoComm-Asym			10.147***			-0.060
			(2.136)			(0.063)
Flex x Comm-Asym			13.307***			-0.073
			(2.832)			(0.063)
Price increment				-0.003	-0.013***	-0.003
				(0.002)	(0.001)	(0.002)
Price inc x Asym				0.006*	0.008***	0.006*
				(0.003)	(0.001)	(0.003)
Price inc x Flex						-0.010***
						(0.002)
Price inc x Flex x Asym						0.002
						(0.003)
Constant	44.525***	48.251***	44.525***	0.125***	0.402***	0.125***
	(0.627)	(0.813)	(0.627)	(0.026)	(0.056)	(0.026)
Observations	794	1,680	2,474	794	1,680	2,474
R-squared	0.056	0.096	0.238	0.010	0.133	0.110

Notes: All estimations are OLS estimations. *Comm-Sym*, *NoComm-Asym*, and *Comm-Asym* are treatment dummies (the baseline category is *NoComm-Sym*). *Flexible Contract* is an indicator variable for observations with a flexible contract. *Price increment* is the price paid minus. Standard errors adjusted for clustering at the session level in parantheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 5: Regression Analysis – Profits and Surplus

	(1)	(2)	(3)	(4)	(5)	(6)	
Dependent Variable	Profit Buyer	Profit Buyer	Profit Buyer	Profit Buyer	Profit Seller	Profit Seller	Pro
Contract	Rigid	Flexible	Both	Both	Rigid	Flexible	
State of the world	Good	Good	Good	Both	Good	Good	
Comm-Sym	0.657	-10.906***	0.657	2.277	-3.835***	13.343***	-3
	(1.729)	(2.604)	(1.728)	(4.097)	(1.115)	(2.006)	(
NoComm-Asym	4.495**	-4.798	4.495**	-1.267	-4.877***	5.377**	-4
	(1.691)	(2.944)	(1.690)	(3.872)	(0.847)	(2.348)	(
Comm-Asym	0.435	-9.790***	0.435	0.630	-1.666	12.026***	
	(2.464)	(2.989)	(2.463)	(4.009)	(1.217)	(2.304)	(
Flexible Contract			-8.814***	-3.743			3
			(1.930)	(2.563)			(
Flex x Comm-Sym			-11.564***	-8.920**			17
			(2.879)	(3.846)			(
Flex x NoComm-Asym			-9.292***	-6.020**			10
			(2.293)	(2.752)			(
Flex x Comm-Asym			-10.225***	-11.367**			13
			(3.196)	(4.576)			(
Constant	91.633***	82.819***	91.633***	77.519***	24.045***	27.135***	24
	(1.009)	(2.353)	(1.008)	(2.942)	(0.675)	(0.682)	(
Observations	794	1,680	2,474	3,072	794	1,680	
R-squared	0.015	0.053	0.196	0.038	0.056	0.092	

Notes: All estimations are OLS estimations. *Comm-Sym*, *NoComm-Asym*, and *Comm-Asym* are treatment dummies (the baseline category is *NoComm-Sym*). *Flexible Contract* is an indicator variable for observations with a flexible contract. Standard errors adjusted for clustering at the session level in parantheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 6: Overall Impact of Communication – Regression Analysis

	(1)	(2)	(3)	(4)	(5)
Dependent variable	Profit Buyer	Profit Seller	Surplus	Shading	Flex. Contr.
CommSym	-4.536	8.195***	3.659	-0.015	0.030
	(2.650)	(1.293)	(2.266)	(0.039)	(0.058)
NoCommAsym	-4.694	0.521	-4.173	0.001	-0.094
	(3.241)	(1.545)	(2.848)	(0.038)	(0.078)
CommAsym	-6.212**	5.118***	-1.094	-0.019	-0.090
	(2.906)	(1.565)	(2.447)	(0.050)	(0.073)
Constant	74.819***	23.586***	98.405***	0.166***	0.721***
	(2.243)	(0.292)	(2.106)	(0.035)	(0.055)
Observations	3,072	3,072	3,072	2,769	3,072
R-squared	0.006	0.041	0.007	0.001	0.014

Notes: All estimations are OLS estimations. *Comm-Sym*, *NoComm-Asym*, and *Comm-Asym* are treatment dummies (the baseline category is *NoComm-Sym*). Standard errors adjusted for clustering at the session level in parantheses. *** p<0.01, ** p<0.05, * p<0.1.

and Column (1) of 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: Treatment Conditions

	Symmetric Information	Asymmetric Information
No Communication	NoComm-Sym	NoComm-Asym
Communication	Comm-Sym	Comm-Asym

Table 3: Impact of Communication on Outcomes under Symmetric Information

	No Communication				Communication			
Contract	Rigid		Flexible		Rigid		Flexible	
State	Good	Bad	Good	Bad	Good	Bad	Good	Bad
Price	44.5	-	48.3	95.0	41.0	-	61.3	95.0
Shading	0.10	-	0.22	0.06	0.17	-	0.17	0.03
Auction Outcome	44.4		42.3		41.4		36.7	
Realized	1.00	0.00	1.00	1.00	1.00	0.00	1.00	1.00
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	77.5		73.8		79.8		67.1	
	74.8				70.3			
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	23.6				31.8			
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	99.1		98.1		98.5		103.3	
	98.4				102.1			
Contract Choice	0.28		0.72		0.25		0.75	

Notes: The table summarizes the main outcomes in rigid and flexible contracts in the two treatments with symmetric information (NoComm-Sym (left) and Comm-Sym (right)). *Price* is the average final price paid by the buyer to the seller. *Shading* is the shading rate (relative frequency with which the sellers pick low quality). *Auction outcome* is the fixed price (rigid contracts) or the lower bound of the price range (flexible contracts) determined in the competitive auction (irrespective of whether trade eventually occurred or not). *Realized* is the frequency with which trade took place. *Profit Buyer* and *Profit Seller* are average profits of the trading parties and *Surplus* is the sum of these payoffs.

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	(1)	(2)	(3)	(4)	(5)	(6)
Dependent Variable	Price	Price	Price	Shading	Shading	Shading
Contract	Rigid	Flexible	Both	Rigid	Flexible	Both
State of the world	Good	Good	Good	Good	Good	Good
Comm-Sym	-3.482***	13.072***	-3.482***	0.060**	0.122**	0.060**
	(1.122)	(1.965)	(1.121)	(0.028)	(0.051)	(0.028)
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				(0.002)	(0.001)	(0.002)
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Table 5: Regression Analysis – Profits and Surplus

Column (4) presents the same regression for rigid contracts in the good state. We also observe a statistically significant increase in shading for given prices in rigid contracts, but the effect is much smaller than in flexible contracts. Figure 3: Effect of Granting Access to Communication on the Price Distribution under Symmetric Information

	(1)	(2)	(3)	(4)	(5)	(6)	
Dependent Variable	Profit Buyer	Profit Buyer	Profit Buyer	Profit Buyer	Profit Seller	Profit Seller	Pro
Contract	Rigid	Flexible	Both	Both	Rigid	Flexible	
State of the world	Good	Good	Good	Both	Good	Good	
Comm-Sym	0.657	-10.906***	0.657	2.277	-3.835***	13.343***	-3
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Comm-Asym	0.435	-9.790***	0.435	0.630	-1.666	12.026***	
	(2.464)	(2.989)	(2.463)	(4.009)	(1.217)	(2.304)	(
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			(2.293)	(2.752)			(
Flex x Comm-Asym			-10.225***	-11.367**			13
			(3.196)	(4.576)			(
Constant	91.633***	82.819***	91.633***	77.519***	24.045***	27.135***	24
	(1.009)	(2.353)	(1.008)	(2.942)	(0.675)	(0.682)	(
Observations	794	1,680	2,474	3,072	794	1,680	
R-squared	0.015	0.053	0.196	0.038	0.056	0.092	

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) and buyer profits do therefore not decrease in rigid contracts.

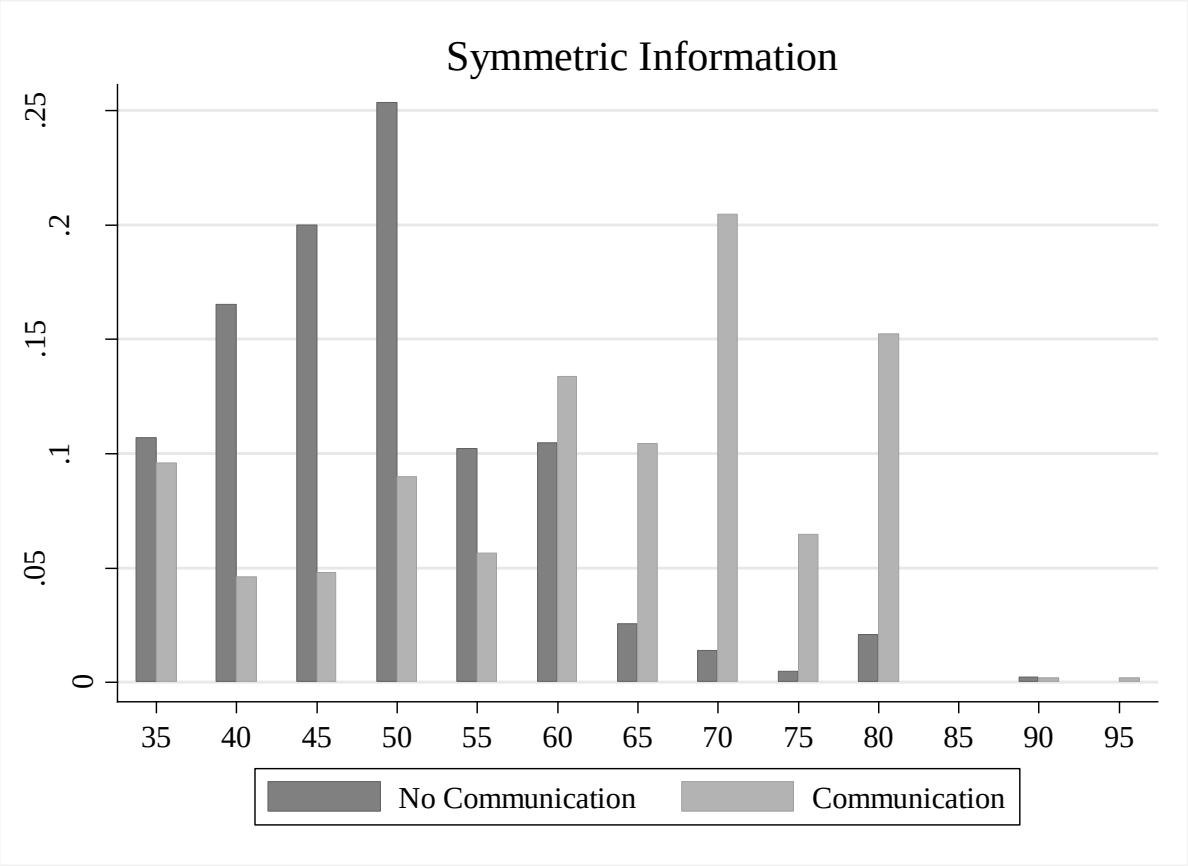

Symmetric Information
0
.05
.1
.15
.2
.25
35
40
45
50
55
60
65
70
75
80
85
90
95
No Communication
Communication

Figure igure 4 graphically displays the impact of the availabliltiy of the communication technology on shading behavior in the good state of the world in the two types of contracts. Panel A is based on observations in rigid contracts and Panel B on those in flexible contracts. On the horizontal axis prices are displayed in bins of 10. The bottom part of each panel displays how often prices in the corresponding bin have been chosen in NoComm-Sym (dark bars) and Comm-Sym (light bars). The top part of each panel shows the shading rates in of sellers NoComm-Sym (squares) and Comm-Sym (circles) as a function of prices paid by buyers. The figure confirms that the shading rate in flexible contracts shifts up; the effect is clearly most pronounced at low prices.

Our third result describes the effect of the availability of the communication technology on profits and surplus:

Result 3 (Impact of the availability of communication on profits in flexible contracts):
The availability of the costless, free-form communication technology strongly reduces the profitability of flexible contracts for buyers. Sellers who manage to obtain a flexible contract, in contrast, strongly benefit from the availability of the communication technology.

Figure 3: Effect of Granting Access to Communication on the Price Distribution under Symmetric Information

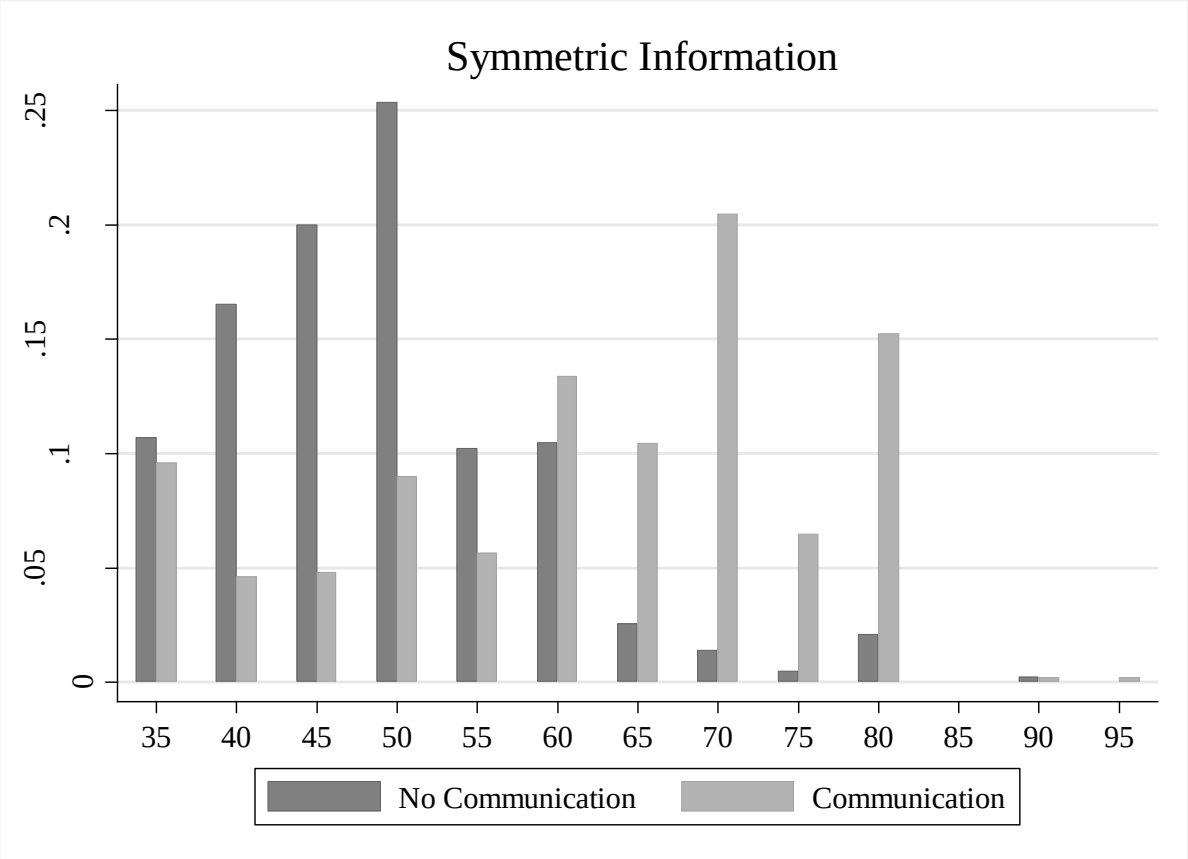


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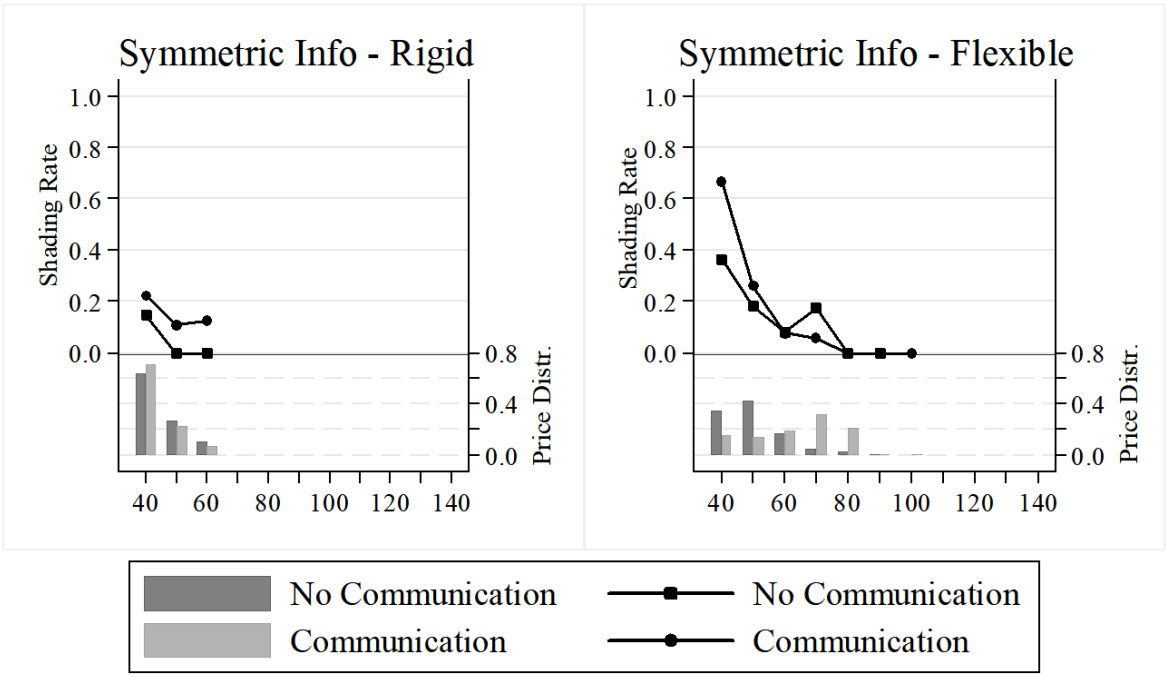


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	No Communication				Communication			
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Contract Choice	0.28		0.72		0.25		0.75	

Notes: The table summarizes the main outcomes in rigid and flexible contracts in the two treatments with symmetric information (NoComm-Sym (left) and Comm-Sym (right)). *Price* is the average final price paid by the buyer to the seller. *Shading* is the shading rate (relative frequency with which the sellers pick low quality). *Auction outcome* is the fixed price (rigid contracts) or the lower bound of the price range (flexible contracts) determined in the competitive auction (irrespective of whether trade eventually occurred or not). *Realized* is the frequency with which trade took place. *Profit Buyer* and *Profit Seller* are average profits of the trading parties and *Surplus* is the sum of these payoffs.

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Price increment				-0.003	-0.013***	-0.003
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Constant	44.525***	48.251***	44.525***	0.125***	0.402***	0.125***
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	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Dependent Variable	Profit Buyer	Profit Buyer	Profit Buyer	Profit Buyer	Profit Seller	Profit Seller	Profit Seller	Profit Seller	Surplus
Contract	Rigid	Flexible	Both	Both	Rigid	Flexible	Both	Both	Both
State of the world	Good	Good	Good	Both	Good	Good	Good	Both	Both
Comm-Sym	0.657	-10.906***	0.657	2.277	-3.835***	13.343***	-3.835***	-2.957***	-0.680
	(1.729)	(2.604)	(1.728)	(4.097)	(1.115)	(2.006)	(1.115)	(0.998)	(4.368)
NoComm-Asym	4.495**	-4.798	4.495**	-1.267	-4.877***	5.377**	-4.877***	-4.564***	-5.831
	(1.691)	(2.944)	(1.690)	(3.872)	(0.847)	(2.348)	(0.847)	(0.740)	(4.151)
Comm-Asym	0.435	-9.790***	0.435	0.630	-1.666	12.026***	-1.666	-1.338	-0.708
	(2.464)	(2.989)	(2.463)	(4.009)	(1.217)	(2.304)	(1.217)	(0.926)	(3.914)
Flexible Contract			-8.814***	-3.743			3.090**	2.730**	-1.013
			(1.930)	(2.563)			(1.132)	(1.032)	(2.778)
Flex x Comm-Sym			-11.564***	-8.920**			17.179***	14.735***	5.816
			(2.879)	(3.846)			(2.694)	(2.417)	(4.645)
Flex x NoComm-Asym			-9.292***	-6.020**			10.254***	8.510***	2.491
			(2.293)	(2.752)			(2.226)	(1.843)	(3.351)
Flex x Comm-Asym			-10.225***	-11.367**			13.692***	10.612***	-0.755
			(3.196)	(4.576)			(2.832)	(2.198)	(4.307)
Constant	91.633***	82.819***	91.633***	77.519***	24.045***	27.135***	24.045***	21.617***	99.136***
	(1.009)	(2.353)	(1.008)	(2.942)	(0.675)	(0.682)	(0.674)	(0.608)	(3.254)
Observations	794	1,680	2,474	3,072	794	1,680	2,474	3,072	3,072
R-squared	0.015	0.053	0.196	0.038	0.056	0.092	0.219	0.158	0.008

Notes: All estimations are OLS estimations. *Comm-Sym*, *NoComm-Asym*, and *Comm-Asym* are treatment dummies (the baseline category is *NoComm-Sym*). *Flexible Contract* is an indicator variable for observations with a flexible contract. Standard errors adjusted for clustering at the session level in parantheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 6: Overall Impact of Communication – Regression Analysis

	(1)	(2)	(3)	(4)	(5)
Dependent variable	Profit Buyer	Profit Seller	Surplus	Shading	Flex. Contr.
CommSym	-4.536	8.195***	3.659	-0.015	0.030
	(2.650)	(1.293)	(2.266)	(0.039)	(0.058)
NoCommAsym	-4.694	0.521	-4.173	0.001	-0.094
	(3.241)	(1.545)	(2.848)	(0.038)	(0.078)
CommAsym	-6.212**	5.118***	-1.094	-0.019	-0.090
	(2.906)	(1.565)	(2.447)	(0.050)	(0.073)
Constant	74.819***	23.586***	98.405***	0.166***	0.721***
	(2.243)	(0.292)	(2.106)	(0.035)	(0.055)
Observations	3,072	3,072	3,072	2,769	3,072
R-squared	0.006	0.041	0.007	0.001	0.014

Notes: All estimations are OLS estimations. *Comm-Sym*, *NoComm-Asym*, and *Comm-Asym* are treatment dummies (the baseline category is *NoComm-Sym*). Standard errors adjusted for clustering at the session level in parantheses. *** p<0.01, ** p<0.05, * p<0.1.

shows that in the symmetric information environment buyer profits in the good state of the world remain roughly constant in rigid contracts (91.6 (NoComm-Sym) vs. 92.3), but decrease substantially in flexible contracts (82.8 (NoComm-Sym) vs. 71.9 (Comm-Sym)). Columns (1) and (2) of Table 5 regress buyer profits in the good state on treatment dummies (NoComm-Sym being the omitted category). The non-signifcant coefficient of *Comm-Sym* in Column (1) indicates that the difference in rigid contracts is not significant ($p = 0.707$). In flexible contracts, however, the difference is highly significant (see Column (2), $p < 0.001$). The same pattern is also present in overall buyer profits (both states) for the two contract types. Buyer profits in rigid contracts show no significant difference (77.5 (NoComm-Sym) vs. 79.8 (Comm-Sym), $p = 0.584$, see Column (4) of Table 5), but those in flexible contracts drop significantly (73.8 (NoComm-Sym) vs. 67.1 (Comm-Sym), $p = 0.016$). Seller profits generally move in the opposite direction of buyer profits. Most importantly, seller profits increase very strongly and significantly in flexible contracts (24.3 (NoComm-Sym) vs. 36.1 (Comm-Sym), $p < 0.001$, see Column (6) of Table). In rigid contracts seller profits decrease somewhat (21.6 (NoComm-Sym) vs. 18.7 (Comm-Sym), $p = 0.002$, see Column (5) of Table 5).

Table 6, finally, reports regressions that investigate the impact of the communication technology on contract choice, overall profits (across both contract types) and overall surplus. Column (1) shows that despite the fact that the availability of the communication technology renders rigid contracts more attractive relative to flexible contracts (see the significant interaction term *Flex x Comm-Sym* in Colum (4) of Table 5), buyers do not choose flexible contracts less often in Com-Sym (75 percent) than in NoComm-Sym (72 percent, $p = 0.612$). Overall realized surplus also remains unaffected by the communication technology (98.4 (NoComm-Sym) vs. 102.1 (Comm-Sym), $p = 0.120$, see Column (4) of Table 6). However, there is a significant redistribution effect in that sellers manage to get a larger part of the surplus (23.6 (NoComm-Sym) vs. 31.8 (Comm-Sym), $p < 0.001$, see Column (4) of Table 6).

The pattern described above is largely in line with the ineffective communication hypothesis. It seems that sellers succeed in using the communication technology to convince buyers in flexible contracts to increase their price offers. Moreover, the seller's influence activities also seem to have the predicted impact on their shading behavior. Overall, seller respond more harshly if buyers decide to offer low prices in flexible contracts and they also seem to punish buyers somewhat more for the choice of rigid contracts. These two effects together render flexible contracts much less profitable for buyers. Somewhat surprisingly, however, buyers do not move away from flexible contracts, so that sellers are able to obtain a

larger part of available surplus. In our setting with symmetric information, the availability of a communication technology does therefore not increase overall efficiency, but has mostly redistributive effects.

IV.B. Use of Communication and Communication Content under Symmetric Information

In this section we show that the pattern of communication use and the content of the messages exchanged between trading parties provides further support for the interpretation that the changes in contractual outcomes presented in the previous section are a consequence of influence activities.

Our fourth results concerns to degree to which the trading parties make use of the costless, free-form communication technology:

Result 4 (Use of the communication technology under symmetric information):
Overall about 77 percent of the pairs who have access to the communication technology (including pairs who do not conclude a contract) do actually activate it. Among pairs who end up in a flexible contract activation of the communication technology is very common (94 percent). In pairs with rigid contracts, in contrast, the share of pairs who activate the communication technology is substantially smaller (74 percent). If communication attempts are blocked by one party, it is always the buyer who refuses to activate the technology.

Table 7 summarizes the data on the use of the communication technology. The top part of the table reports how often the communication technology was activated and how often pairs actually exchange messages (these numbers differ, because some pairs turned on the communication technology (i.e. they opened up a communication channel), but never sent a message to each other). The table reveals that 77 percent of all pairs who have access to the communication technology do activate it and 70 percent actually exchange messages. This includes both pairs who concluded a contract and pairs who did not conclude a contract (remember: in the initial phase of a period (before contracts have been auctioned off) each trading party can contact the two parties of the other type in his or her group). If the analysis is restricted to pairs who conclude a contract, the data shows that the frequency with which pairs communicate is correlated with the type of contract they conclude. Specifically, communication is significantly more frequent among pairs with flexible contracts than among pairs with rigid contracts. 94 percent of the pairs with flexible contracts activate the technology and 90 percent exchange messages. In rigid contracts the corresponding numbers are 76 percent (activation) and 69 percent (exchange). Both these differences are statistically

significant (activation: p = 0.013 / exchange: p = 0.011), but we want to emphasize that these findings are based on correlations that cannot be interpreted causally. Both contract choice and communication activities are endogenous and it is plausible that they are interdependent. Further analysis reveals that pairs in flexible contracts are also more likely to exchange messages ex post (63 percent) than pairs in rigid contracts (45 percent, p = 0.044), but also this comparison cannot be interpreted causally, because more communicative types may self-select into flexible contracts.

The middle part of Table 7 reveals that sellers are more likely to initiate communication than buyers. Among all the communication pairs sellers initiate the communication in 71 percent of the cases. When the sample is restricted to pairs with contracts, sellers initiate communication in 64 percent in rigid contracts and in 72 percent in flexible contracts. Moreover, the bottom part of Table 7 reveals that the absence of communication is not always the result of a joint decision not to communicate. Sometimes communication is blocked by one party although the other party would like to communicate. Our data indicate that blocking happens in 17 percent of all not communicating pairs and in 28 percent of the pairs who have a contract, but do not communicate. In all those cases, the communication attempt comes from the seller and the buyer blocks it.[21]

The fifth result is concerned with the content of the messages that the trading parties exchange through the communication technology:[22]

Result 5 (Content of messages sent under symmetric information):
The by far most frequently observed content categories all refer to influence activities. Sellers often try to convince buyers to choose flexible contracts and/or to choose high prices once a flexible contract has been chosen. In many cases, sellers combine their requests with a promise that they will choose normal quality if the buyer respects their wishes. Explicit threats, in contrast, are only used rarely. Attempts of buyers to engage in damage control do occur, but they are less frequent than the influencing activities of the sellers. We find almost

[21] Blocking occurs in two forms. Buyers can either refuse to respond or explicitly rejecting the call. The latter form of blocking is almost never observed.

[22] These results are preliminary and the details will change in later versions of the paper. The reason is that Result 5 is based on the data of two sessions coded by the authors themselves. We are currently performing the coding of the full data set using three research assistants who code the chat protocols independently and are blind to the research question that we investigate.

no evidence that buyers use communication to manage sellers' expectations with low price announcements for flexible contracts.

Support for Result 5 comes from codings of the content of messages exchanged between the trading parties. To establish this data, we hired three research assistants who independently coded the 9291 messages exchanged in 1124 chat conversations of participants in the Comm-Sym treatment. We defined the following coding categories based on our two competing communication hypotheses:

Categories based on the Effective-Communication-Hypothesis:

Ex-ante Expectations Management (ExpM): The buyer tries to lower the seller's price expectations for the case in which he chooses a flexible contract (only possible before the buyer chooses a contract).

Damage Control (DamC): The buyer tries to reason with the seller in order to convince the seller to abstain from shading and pick the normal quality (possible at any time after the contract has been concluded).

Categories based on the Ineffective-Communication-Hypothesis:

Influencing Contract Choice (InfC): The seller tries to convince the buyer to pick the flexible contract (only possible before the buyer chooses a contract).

Influencing Price (InfP): The seller tries to convince the buyer to choose a high price in a flexible contract (possible at any time after a flexible contract has been concluded).

Quality Promise (QuaP): The seller promises to the buyer that he chooses the normal quality if the seller picks the flexible contract and pays a high price (possible either before the contract is concluded or before the buyer determines the price in a flexible contract).

Shading Threat (ShaT): The seller threatens to engage in shading should the buyer refrain from picking a flexible contract and paying a high price (possible either before the contract is concluded or before the buyer determines the price in a flexible contract).

The assistants coded each message for the presence of statements consistent with each coding category (binary codings: 0 = "not present", 1 = "present").[23] It was possible that multiple categories were positively coded for a statement. As a measure of intercoder-agreement we use Krippendorff's alpha, which is considered to be the most conservative reliability measure (Hayes and Krippendorff 2007): *ExpM*: $\alpha = 0.29$, *DamC*: $\alpha = 0.83$, *InfC*: $\alpha = 0.88$, *InfP*: $\alpha = 0.76$, *QuaP*: $\alpha = 0.85$, *ShaT*: $\alpha = 0.73$. With the exception of *Ex-Ante Expectations Management* (which rarely ever occurs) all categories are reliably coded according to the conventional standards in the literature (the cut-off value proposed by Krippendorff is $\alpha = 0.67$).

To aggregate the data across coders we follow Krippendorff (2004, p. 219) who recommends to use at least three coders and suggests majority decisions as one possible "formal decision rule" to assign final codes. We therefore coded a category as being present in a message if at least two of the coders had the category positively coded. Next we aggregated the codings to the conversation level, where a category was coded as present if the category had been positively coded for at least one message belonging to the conversation.

Table 8 provides an overview of the frequency with which participants make statements in the chat conversations that are in line with the different categories. The coding data confirm that communication is predominantly used for influence activities. If we focus on all those pairs who engage in pre-contract conversations (i.e., they exchange messages w before the buyer selects a contract), we observe that sellers frequently ask for flexible contracts (67 percent) and high prices (62 percent) and often promise to deliver normal quality if the buyer grants them their requests (56 percent). Interestingly, only very few sellers make threats instead of or in addition to promises (5 percent). Attempts from buyers to manage the expectations of sellers by making low price announcements for flexible contracts do almost never occur (2 percent). If we shift our attention to pairs who successfully concluded a contract, we find further evidence for the importance of influence activities. In conversations of pairs with flexible contracts the vast majority of sellers asks for high prices at some point of the conversation (91 percent). Very often these price requests are combined with promises to deliver high quality (76 percent), but only infrequently with threats (9

[23] The appendix provides more detail on the coding procedures.

percent). Attempts to engage in damage control occur with some frequency in both types of contracts (Rigid: 26 percent / Flexible: 33 percent).

Results 4 and 5 provide further support for the ineffective communication hypothesis. We find that communication is more often initiated by sellers than by buyers. Some buyers actually reject communication attempts of seller. If communication takes place, it is most frequently used by sellers who try to convince buyer to choose flexible contracts and to pay high prices.

The sixth results summarizes contract outcomes of communicating and not communicating pairs in the CommSym condition:

Result 6 (Contract outcomes of communicating and not communicating pairs):
Buyers who pick rigid contracts and do not communicate with sellers reach the lowest shading rate in the good state of the world and maximize overall profits (as well as surplus).

Table 9 summarizes prices, shading rates, auction outcomes, buyer and seller profits, and surplus for not communicating and communicating pairs in the CommSym condition. The table reveals that buyers who pick rigid contracts and do not communicate with sellers have the lowest shading rate (0.10) and the highest profit (86.5). Buyers who choose rigid contracts and do communicate have the second highest profit (77.7). The shading rate in those contracts amounts to 0.19. Even within flexible contracts buyers are better off in terms of profits if no communication takes place (73.2 vs. 66.8). The main reason for this latter finding is that prices in flexible contracts with communication are very high (62.2) and the shading rate is still surprisingly high (0.16).

While these results cannot be interpreted as causal effects of communication, they nevertheless illustrate that communication in our setup does not have the effective, conflict-reducing effect that has been documented in other environments.

IV.C. Impact of Asymmetric Information on Outcomes

This section explores how ex-post asymmetric information about the seller's cost affects contractual outcomes and the use of communication. Our results indicate that under asymmetric information the availability of the communication technology leaves the trade-off between contractual rigidity and flexibility fully intact. Influence activities allow sellers to slightly increase their profits in flexible contracts. Overall, the use of the communication

technology is significantly less intense under asymmetric information than under symmetric information.

Our seventh result compares contractual outcomes under asymmetric information across treatments with and without communication:

Result 7 (Impact of asymmetric information on outcomes):
The effects of the availability of the communication technology on outcomes in rigid and flexible contracts under asymmetric information are similar to those under symmetric information. In the presence of the communication technology prices in flexible contracts increase in the low-cost state and the shading rate decreases slightly. However, since outcomes in rigid contracts do not change substantially, the shading rate in flexible contract remains higher than in rigid contracts. As a consequence, the trade-off that buyers face between contractual rigidity and flexibility remains largely unaffected by the presence of the communication technology.

Table 10 provides an overview of the outcomes in different contract types in the NoComm-Asym and the Comm-Asym conditions. We first focus on the good state of the world. We observe that in both treatments prices and shading rates in the good state are lower in rigid contracts than in flexible contracts (NoComm-Asym: 39.7/0.10 (rigid) vs. 53.6/0.22 (flexible) / Comm-Asym: 43.0/0.12 (rigid) vs. 60.0/0.17 (flexible)). The regression analysis in Table 4 confirms that these differences are statistically significant in both treatments (NoComm-Asym: $p < 0.001$ (prices), $p < 0.001$ (shading rate) / Comm-Asym: $p < 0.001$ (prices), $p < 0.001$ (shading rate)). The availability of communication does therefore not eliminate the advantage of the rigid contract in the good state of the world.

In the bad state trade is only feasible in flexible contracts. However, different than in the case of symmetric information, flexible contracts guarantee trade only in 20 percent of the cases under asymmetric information (i.e., when the buyer is informed about the seller's high cost level). In the other 80 percent of the cases trade only takes place if the seller succeeds in convincing the buyer that the cost is high. In the absence of a communication opportunity, the only action the seller can take is to send a structure, cheap-talk signal about his cost level to the buyer. In the communication treatment, in contrast, the seller and the buyer can also use the chat function to discuss the cost level of the seller. Our data reveal that the availability of the communication technology helps to increase the information content of the cheap-talk signal to some extent: the probability that the cost is truly high conditional on having received a high-cost signal is 24 percent in NoComm-Asym and 32 percent in Comm-Asym ($p =$

0.071). Moreover, the availability of communication implies that the trading parties succeed more often in trading in the high-cost state when the buyer is not informed about the cost level. In the NoComm-Asym condition the trade frequency in flexible contracts with high costs is 33 percent and in the Comm-Asym condition this number increases to 41 percent. However, the effect remains rather small and is not statistically significant ($p = 0.337$).

Taken together, these results imply that the trade-off between contractual rigidity and flexibility is present irrespective of the availability of the communication technology. We find that buyer profits in rigid contracts are higher than in flexible contracts in both treatments (NoComm-Asym: 76.3 (rigid) vs. 66.5 (flexible) / Comm-Asym: 78.1 (rigid) vs. 63.0 (flexible)). Both differences are significant (see the regressions in Table 5, $p < 0.001$ in both cases). Moreover, buyer profits in both types of contracts are not substantially affected by the presence of the communication technology. Profits in rigid contracts increase marginally and profits in flexible contracts decrease, but neither difference is statistically significant ($p = 0.614$ (rigid), $p = 0.241$ (flexible)). Seller profits, in contrast, are always higher in flexible contracts (NoComm-Asym: 17.1 (rigid) vs. 28.3 (flexible) / Comm-Asym: 20.3 (rigid) vs. 33.6 (flexible)). Both differences are statistically significant (see Table 5, $p < 0.001$ in both cases). Contrary to our findings under symmetric information, sellers fail to benefit substantially from the availability of the communication technology under asymmetric information. Although seller profits in flexible contracts increase somewhat in Comm-Asym (33.6) relative to NoComm-Asym (28.3), the effect is not statistically significant ($p = 0.480$).[24]

Our results indicate that communication is largely ineffective in our environment with asymmetric information about the cost level. There are neither beneficial effects nor large detrimental effects. Structurally, outcomes essentially remain unchanged under the availability of the communication technology.

Our eight result concerns the use of the communication technology under asymmetric information:

Result 8 (Use of communication under asymmetric information):
Under asymmetric information the communication technology is less frequently used than under symmetric information. Overall only 51 percent of the pairs who have access to the communication technology (including pairs who do not conclude a contract) do actually

[24] The impact on profits in flexible contracts is significant if only the low-cost state is considered ($p = 0.039$).

activate it. Among pairs who end up in a flexible contract 75 percent use the opportunity to communicate. In pairs with rigid contracts only 52 percent activate a communication channel. If communication attempts are blocked by one party, it is mostly the buyer who refuses to activate the technology.

Table 11 summarizes the data on the use of the communication technology under asymmetric information. The top part of the table reveals that in this treatment only 51 percent of all pairs who have access to the communication technology do activate it and only 42 percent actually exchange messages (these data include pairs who concluded a contract and pairs who did not conclude a contract). Restricting the analysis to pairs with a contract, the data shows that—as under symmetric information—communication is significantly more frequent among pairs with flexible contracts than among pairs with rigid contracts. However, communication is used less frequently in both types of contracts. 75 percent of the pairs with flexible contracts activate the technology and 69 percent exchange messages. In rigid contracts the corresponding numbers are 52 percent (activation) and 41 percent (exchange). Both these differences are statistically significant (activation: $p = 0.018$ / exchange: $p = 0.008$), but—as discussed before—these results are correlational and cannot be interpreted causally. The middle part of Table 11 reveals that sellers are again more likely to initiate communication than buyers. Among all the communication pairs sellers initiate the communication in 70 percent of the cases. When the sample is restricted to pairs with contracts, sellers initiate communication in 61 percent in rigid contracts and in 72 percent in flexible contracts. These results are almost identical to the ones obtained under symmetric information. Moreover, the bottom part of Table 11 reveals that if communication is blocked by one party, it is typically the buyer who refuses to communicate (83 percent).

The ninth result summarizes the content of messages exchanged under asymmetric information:[25]

Result 9 (Content of messages sent under asymmetric information):
Influence activities are even more frequent under asymmetric information than under symmetric information. Attempts to convince buyers to choose flexible contracts are very frequent. Sellers also try very often to lobby for high prices in flexible contracts. In most cases

[25] These results are preliminary and the details will change in later versions of the paper. The reason is that Result 9 is based on the data of two sessions coded by the authors themselves. We are currently performing the coding of the full data set using three research assistants who code the chat protocols independently and are blind to the research question that we investigate.

they do this by claiming that their cost is high. Promises are somewhat less frequent than under symmetric information. Threats, ex ante expectations management, and ex post damage control remain rare.

The same three research assistant who coded the chat conversations of participants in the Comm-Sym treatment also coded the messages recorded in the Comm-Asym treatment (718 conversations containing 4998 messages). We used the exact same procedures and the same coding categories (Ex-ante Expectations Management (ExpM), Damage Control (DamC), Influencing Contract Choice (InfC), Influencing Price (InfP), Quality Promise (QuaP). Shading Threat (ShaT)), but we added one additional category related to the asymmetry of information:

> High-Cost Announcements (HigA): The seller tries to convince the buyer that his or her cost level is high (only possible after the buyer has chosen a contract and nature has determined the cost level).

The intercoder-agreements (Krippendorff's alpha) are similar to the ones obtained for the Comm-Sym treatment , which is considered to be the most conservative reliability measure (Hayes and Krippendorff 2007): *ExpM*: α = 0.39, *DamC*: α = 0.85, *InfC*: α = 0.83, *InfP*: α = 0.70, *QuaP*: α = 0.86, *ShaT*: α = 0.78, *HigA*: α = 0.68 (as before all measures pass the cut-off value (α = 0.67) except for *ExpM* which again rarely occurs.

Table 12 reveals that the communication pattern observed in the Comm-Asym treatment is quite similar to the one in the Comm-Sym treatment. In pre-contract conversations sellers frequently request flexible contracts (72 percent). Interestingly, there is a less strong focus on high prices and promises in flexible contract in the pre-contract phase. Sellers explicitly ask for a high price in only 23 percent of the cases (as compared to 62 percent in Comm-Sym) and make promises in 27 percent of the cases (as compared to 51 percent in Comm-Sym). Threats and attempts to manage expectations remain very rare (2 percent each). However, the data for concluded contracts reveals that overall price requests (68 percent) and promises (59 percent) remain important in flexible contract, but they appear more often once the contract has been concluded rather than before that. Moreover, sellers also use the chat function for attempts to convince the buyer that their cost level is high (38 percent). Attempts to engage in damage control occur again with some frequency in both types of contracts (Rigid: 26 percent / Flexible: 23 percent).

All in all, our results on communication patterns under asymmetric information reinforce the interpretation that communication is mostly used for influencing activities in our competitive contracting environment.

V. Conculsion

We study a contracting situation in which competition leads to substantial payoff inequality in favor of the buyer. Such an environment is challenging, because sellers who receive only a small share of the surplus tend to start efficiency-reducing conflicts. There are reasons to believe that communication might help to improve matters in such a setup. In particular, earlier evidence shows that ex-ante expectations management (in the form of precise announcements of price-setting strategies) and ex-post damage control (in the form of appropriate explanations or justifications of unfavorable outcomes) can reduce the inclination of disfavored parties to engage in conflicts. At the same time, however, the presence of considerable payoff inequality between buyers and seller gives rise to the risk that sellers use communication for influencing activities. Our data reveal that the messages exchanged between parties are indeed dominated by influencing attempts of sellers who try to induce buyers to allocate a larger share of the surplus to them. These influence activities do not help to reduce the tensions between buyers and sellers. On the contrary, in some cases they even increase the conflict potential, because sellers who fail to influence buyers tend to react even more harshly to an unequal payoff allocation. We find that conflicts are minimized if buyers do not communicate with sellers and decide to limit their discretion to respond to influence activities (by picking a rigid contract). Thus, although communication seems to have powerful, efficiency-enhancing effects in many environments, there are also settings in which communication remains ineffective and contractual solutions are needed to improve outcomes.

References:

Andersson, Ola, and Erik Wengström. 2012. “Credible Communication and Cooperation: Experimental Evidence from Multi-Stage Games." Journal of Economic Behavior & Organization 81(1): 207-219.

Andersson, Ola, Matteo M. Galizzi, Tim Hoppe, Sebastian Kranz, Karen van der Wiel, and Erik Wengström. 2010. “Persuasion in Experimental Ultimatum Games.” Economics Letters 108(1): 16-18.

Bartling, Björn, and Klaus M. Schmidt. 2015. “Reference Points, Social Norms, and Fairness in Contract Renegotiations.” Journal of the European Economic Association, 13: 98–129.

Bartling, Björn, Manuel Grieder, and Christian Zehnder. Forthcoming. “Competitive Pricing Reduces Wasteful Counterproductive Behaviors” Journal of Public Economics.

Blume, Andreas, and Andreas Ortmann. 2007. “The Effects of Costless Pre-play Communication: Experimental Evidence from Games with Pareto-ranked Equilibria.” Journal of Economic theory 132(1): 274-290.

Bochet, Olivier, Talbot Page, and Louis Putterman. 2006. “Communication and Punishment in Voluntary Contribution Experiments.” Journal of Economic Behavior & Organization 60(1): 11-26.

Brandts, Jordi, and David J. Cooper. 2007. “It's What You Say, Not What You Pay: An Experimental Study of Manager-Employee Relationships in Overcoming Coordination Failure.” Journal of the European Economic Association 5(6): 1223-1268.

Brandts, Jordi, Matthew Ellman, and Gary Charness. 2016. “Let’s Talk: How Communication affects Contract Design.” Journal of the European Economic Association, 14: 943–974.

Capra, C. Mónica, Tomomi Tanaka, Colin F. Camerer, Lauren Feiler, Veronica Sovero, Charles N. Noussair. 2009. “The Impact of Simple Institutions in Experimental Economies with Poverty Traps.” The Economic Journal 119(539): 977-1009.

Cason, Timothy N., and Vai-Lam Mui. 2014. “Coordinating Collective Resistance through Communication and Repeated Interaction” The Economic Journal 124: 226-256.

Cason, Timothy N., Sheremeta, R. M., and Jingjing Zhang. 2012. “Communication and efficiency in competitive coordination games.” Games and Economic Behavior, 76: 26–43.

Cason, Timothy N., Sheremeta, R. M., and Jingjing Zhang. 2017. “Asymmetric and endogenous within-group communication in competitive coordination games” Experimental Economics, 20(4): 946–972.

Charness, Gary, and Martin Dufwenberg. 2006. “Promises and Partnership.” Econometrica 74(6): 1579-1601.

Dawes, Robyn M., Jeanne McTavish, and Harriet Shaklee. 1977. “Behavior, Communication, and Assumptions About Other People's Behavior in a Commons Dilemma Situation.” Journal of Personality and Social Psychology 35(1): 1.

Erlei, Mathias and Christian Reinhold. 2016. “Contracts as reference points—The role of reciprocity effects and signaling effects.” Journal of Economic Behavior & Organization, 127: 133-145.

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

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.

Fehr, Ernst, Oliver Hart, and Christian Zehnder. 2015. “How do Informal Agreement and Revision Shape Contractual Reference Points?” Journal of the European Economic Association, 13: 1–28.

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

Gneezy, Uri, Bettina Rockenbach, and Marta Serra-Garcia.2013. “Measuring Lying Aversion.” Journal of Economic Behavior & Organization 93: 293-300.

Gneezy, Uri. 2005. “Deception: The Role of Consequences.” The American Economic Review 95(1): 384-394.

Greenberg, Jerald. 1990. “Employee Theft as a Reaction to Underpayment Inequity: The Hidden Cost of Pay Cuts.” Journal of Applied Psychology 75(5): 561.

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.

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

Isaac, R. Mark, and James M. Walker. 1988. “Communication and Free-Riding Behavior: The Voluntary Contribution Mechanism.” Economic inquiry 26(4): 585-608.

Leibbrandt, Andreas, and Lauri Sääksvuori. 2012. “Communication in intergroup conflicts.” European Economic Review, 56: 1136–1147.

Lundquist, Tobias, Tore Ellingsen, Erik Gribbe, and Magnus Johannesson. 2009. “The Aversion to Lying.” Journal of Economic Behavior & Organization 70(1): 81-92.

Meyer, Margaret, Paul Milgrom, and John Roberts. 1992. “Organizational Prospects, Influence Costs, and Ownership Changes.” Journal of Economics & Management Strategy 1(1): 9-35.

Milgrom, Paul, and John Roberts. 1988. “An Economic Approach to Influence Activities in Organizations.” American Journal of sociology 94: 154-179.

Milgrom, Paul. 1988. “Employment Contracts, Influence Activities, and Efficient Organization Design." Journal of Political Economy 96(1): 42-60.

Ostrom, Elenor., James Walker, and Roy Gardner. 1992. “Covenants with and without a Sword: Self-Governance Is Possible.” American Political Science Review, 86(2), 404-417.

Xiao, Erte, and Daniel Houser. 2005. “Emotion Expression in Human Punishment Behavior." Proceedings of the National Academy of Sciences of the United States of America 102(20): 7398-7401.

Figure 1: Illustration of the Communication Technology

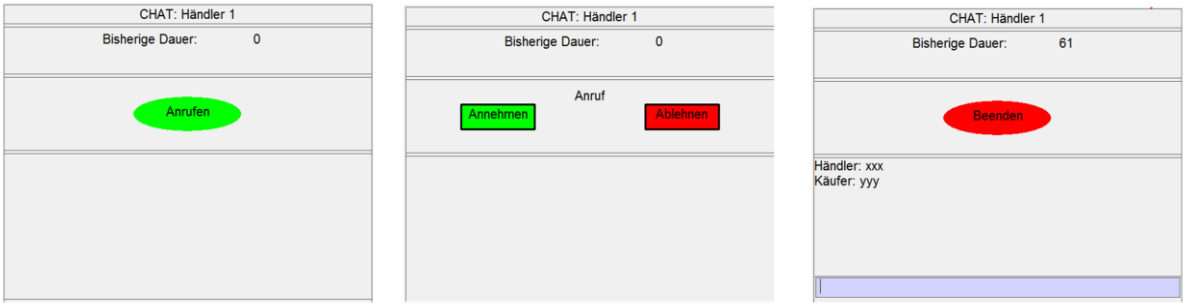


Figure 2: Timeline

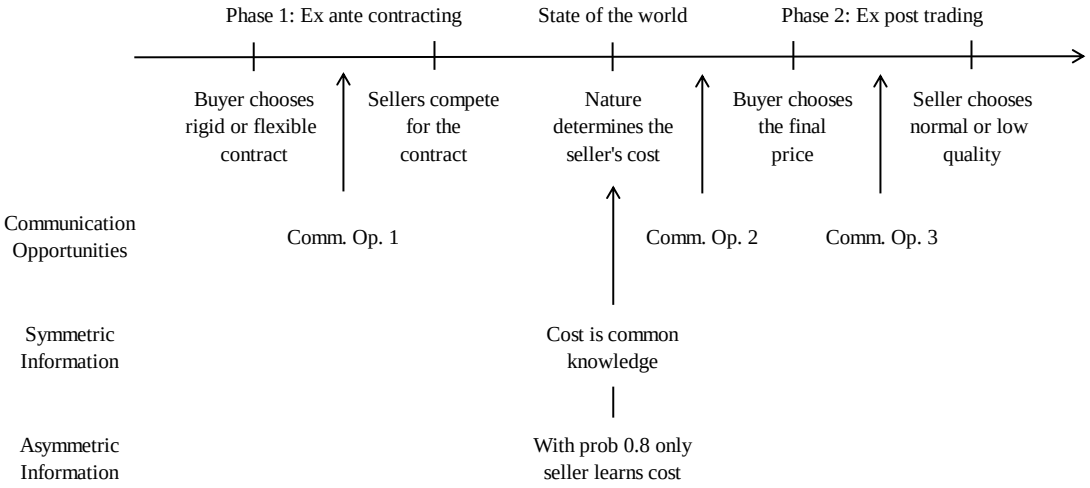


Figure 3: Effect of Granting Access to Communication on the Price Distribution under Symmetric Information

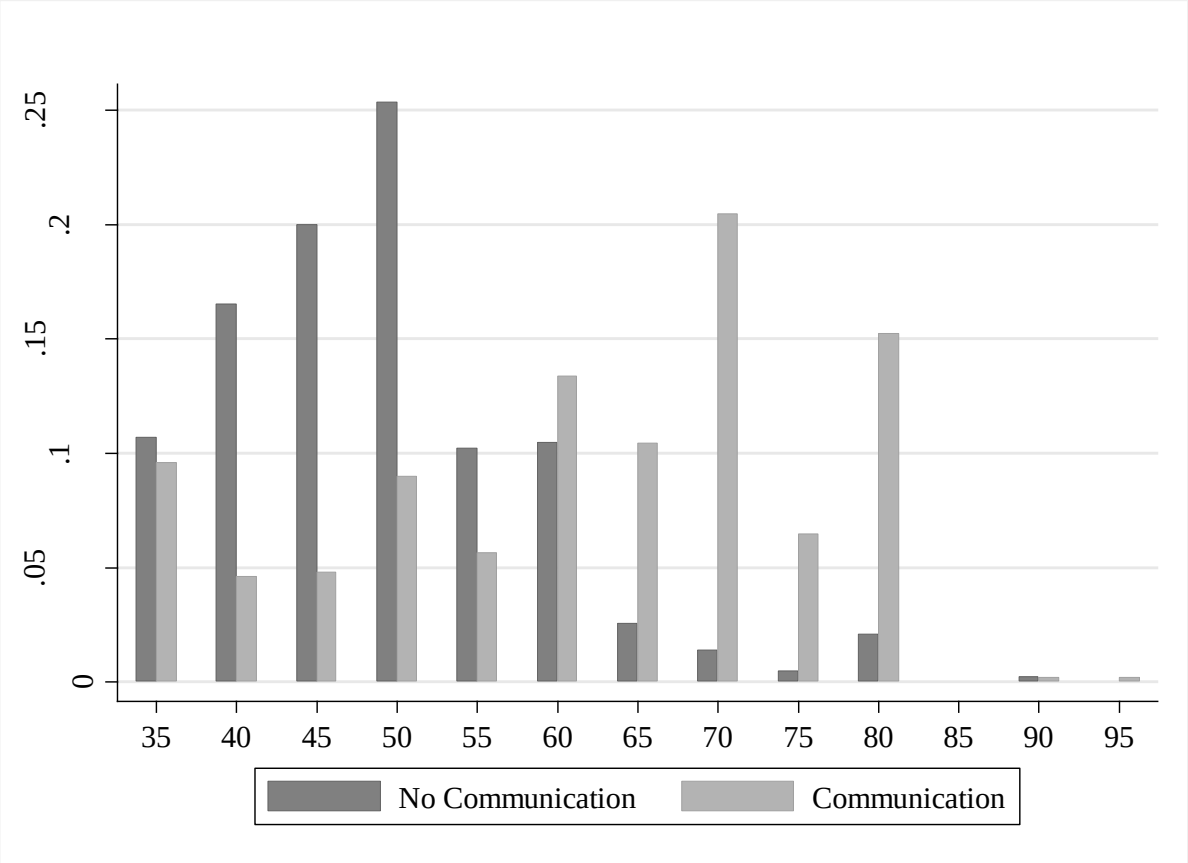


Figure 4: Effect of Granting Access to Communication on Shading Behavior and Prices

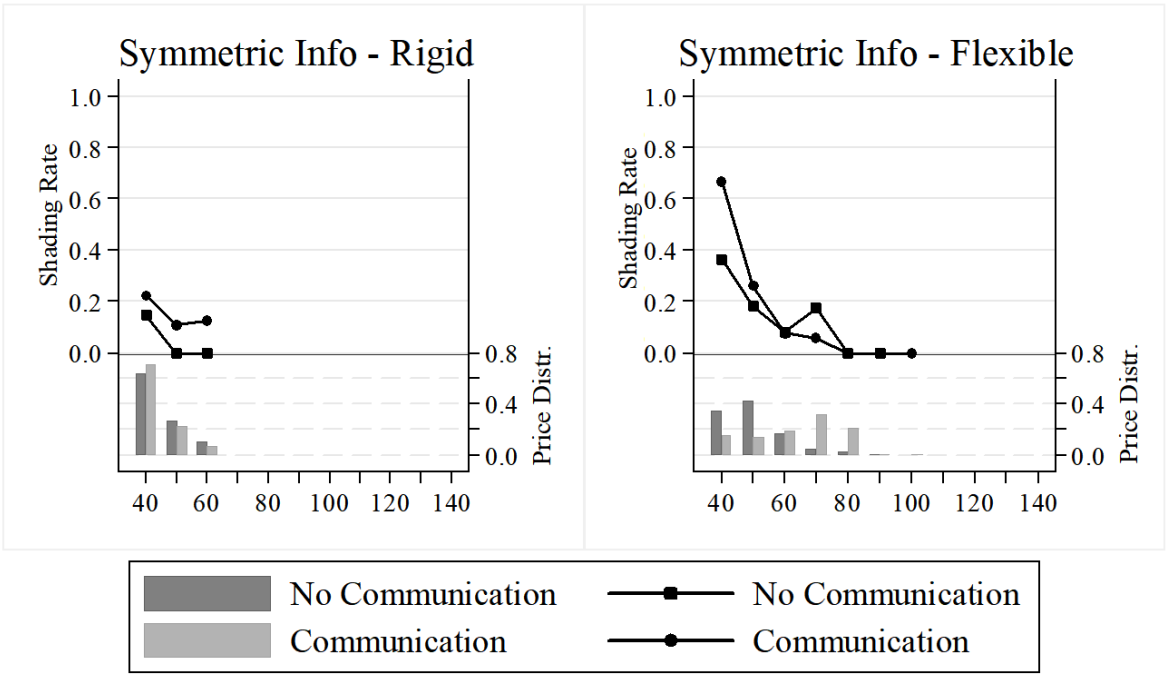


Table 1: Experimental Parameters

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: Treatment Conditions

	Symmetric Information	Asymmetric Information
No Communication	NoComm-Sym	NoComm-Asym
Communication	Comm-Sym	Comm-Asym

Table 3: Impact of Communication on Outcomes under Symmetric Information

	No Communication				Communication			
Contract	Rigid		Flexible		Rigid		Flexible	
State	Good	Bad	Good	Bad	Good	Bad	Good	Bad
Price	44.5	-	48.3	95.0	41.0	-	61.3	95.0
Shading	0.10	-	0.22	0.06	0.17	-	0.17	0.03
Auction Outcome	44.4		42.3		41.4		36.7	
Realized	1.00	0.00	1.00	1.00	1.00	0.00	1.00	1.00
Profit Buyer	91.6	10.0	82.8	42.4	92.3	10.0	71.9	43.8
	77.5		73.8		79.8		67.1	
		74.8				70.3		
Profit Seller	24.0	10.0	27.1	14.7	20.2	10.0	40.5	14.8
	21.6		24.3		18.7		36.1	
		23.6				31.8		
Surplus	115.7	20.0	110.0	57.1	112.5	20.0	112.4	58.6
	99.1		98.1		98.5		103.3	
		98.4				102.1		
Contract Choice	0.28		0.72		0.25		0.75	

Notes: The table summarizes the main outcomes in rigid and flexible contracts in the two treatments with symmetric information (NoComm-Sym (left) and Comm-Sym (right)). *Price* is the average final price paid by the buyer to the seller. *Shading* is the shading rate (relative frequency with which the sellers pick low quality). *Auction outcome* is the fixed price (rigid contracts) or the lower bound of the price range (flexible contracts) determined in the competitive auction (irrespective of whether trade eventually occurred or not). *Realized* is the frequency with which trade took place. *Profit Buyer* and *Profit Seller* are average profits of the trading parties and *Surplus* is the sum of these payoffs.

Table 4: Regression Analysis – Prices and Shading

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent Variable	Price	Price	Price	Shading	Shading	Shading
Contract	Rigid	Flexible	Both	Rigid	Flexible	Both
State of the world	Good	Good	Good	Good	Good	Good
Comm-Sym	-3.482***	13.072***	-3.482***	0.060**	0.122**	0.060**
	(1.122)	(1.965)	(1.121)	(0.028)	(0.051)	(0.028)
NoComm-Asym	-4.835***	5.312**	-4.835***	-0.033	-0.093	-0.033
	(0.856)	(2.315)	(0.856)	(0.034)	(0.066)	(0.034)
Comm-Asym	-1.530	11.777***	-1.530	-0.023	-0.095	-0.023
	(1.264)	(2.260)	(1.264)	(0.044)	(0.075)	(0.044)
Flexible Contract			3.726***			0.277***
			(1.189)			(0.050)
Flex x Comm-Sym			16.555***			0.062
			(2.658)			(0.040)
Flex x NoComm-Asym			10.147***			-0.060
			(2.136)			(0.063)
Flex x Comm-Asym			13.307***			-0.073
			(2.832)			(0.063)
Price increment				-0.003	-0.013***	-0.003
				(0.002)	(0.001)	(0.002)
Price inc x Asym				0.006*	0.008***	0.006*
				(0.003)	(0.001)	(0.003)
Price inc x Flex						-0.010***
						(0.002)
Price inc x Flex x Asym						0.002
						(0.003)
Constant	44.525***	48.251***	44.525***	0.125***	0.402***	0.125***
	(0.627)	(0.813)	(0.627)	(0.026)	(0.056)	(0.026)
Observations	794	1,680	2,474	794	1,680	2,474
R-squared	0.056	0.096	0.238	0.010	0.133	0.110

Notes: All estimations are OLS estimations. *Comm-Sym*, *NoComm-Asym*, and *Comm-Asym* are treatment dummies (the baseline category is *NoComm-Sym*). *Flexible Contract* is an indicator variable for observations with a flexible contract. *Price increment* is the price paid minus. Standard errors adjusted for clustering at the session level in parantheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 5: Regression Analysis – Profits and Surplus

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Dependent Variable	Profit Buyer	Profit Buyer	Profit Buyer	Profit Buyer	Profit Seller	Profit Seller	Profit Seller	Profit Seller	Surplus
Contract	Rigid	Flexible	Both	Both	Rigid	Flexible	Both	Both	Both
State of the world	Good	Good	Good	Both	Good	Good	Good	Both	Both
Comm-Sym	0.657	-10.906***	0.657	2.277	-3.835***	13.343***	-3.835***	-2.957***	-0.680
	(1.729)	(2.604)	(1.728)	(4.097)	(1.115)	(2.006)	(1.115)	(0.998)	(4.368)
NoComm-Asym	4.495**	-4.798	4.495**	-1.267	-4.877***	5.377**	-4.877***	-4.564***	-5.831
	(1.691)	(2.944)	(1.690)	(3.872)	(0.847)	(2.348)	(0.847)	(0.740)	(4.151)
Comm-Asym	0.435	-9.790***	0.435	0.630	-1.666	12.026***	-1.666	-1.338	-0.708
	(2.464)	(2.989)	(2.463)	(4.009)	(1.217)	(2.304)	(1.217)	(0.926)	(3.914)
Flexible Contract			-8.814***	-3.743			3.090**	2.730**	-1.013
			(1.930)	(2.563)			(1.132)	(1.032)	(2.778)
Flex x Comm-Sym			-11.564***	-8.920**			17.179***	14.735***	5.816
			(2.879)	(3.846)			(2.694)	(2.417)	(4.645)
Flex x NoComm-Asym			-9.292***	-6.020**			10.254***	8.510***	2.491
			(2.293)	(2.752)			(2.226)	(1.843)	(3.351)
Flex x Comm-Asym			-10.225***	-11.367**			13.692***	10.612***	-0.755
			(3.196)	(4.576)			(2.832)	(2.198)	(4.307)
Constant	91.633***	82.819***	91.633***	77.519***	24.045***	27.135***	24.045***	21.617***	99.136***
	(1.009)	(2.353)	(1.008)	(2.942)	(0.675)	(0.682)	(0.674)	(0.608)	(3.254)
Observations	794	1,680	2,474	3,072	794	1,680	2,474	3,072	3,072
R-squared	0.015	0.053	0.196	0.038	0.056	0.092	0.219	0.158	0.008

Notes: All estimations are OLS estimations. *Comm-Sym*, *NoComm-Asym*, and *Comm-Asym* are treatment dummies (the baseline category is *NoComm-Sym*). *Flexible Contract* is an indicator variable for observations with a flexible contract. Standard errors adjusted for clustering at the session level in parantheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 6: Overall Impact of Communication – Regression Analysis

	(1)	(2)	(3)	(4)	(5)
Dependent variable	Profit Buyer	Profit Seller	Surplus	Shading	Flex. Contr.
CommSym	-4.536	8.195***	3.659	-0.015	0.030
	(2.650)	(1.293)	(2.266)	(0.039)	(0.058)
NoCommAsym	-4.694	0.521	-4.173	0.001	-0.094
	(3.241)	(1.545)	(2.848)	(0.038)	(0.078)
CommAsym	-6.212**	5.118***	-1.094	-0.019	-0.090
	(2.906)	(1.565)	(2.447)	(0.050)	(0.073)
Constant	74.819***	23.586***	98.405***	0.166***	0.721***
	(2.243)	(0.292)	(2.106)	(0.035)	(0.055)
Observations	3,072	3,072	3,072	2,769	3,072
R-squared	0.006	0.041	0.007	0.001	0.014

Notes: All estimations are OLS estimations. *Comm-Sym*, *NoComm-Asym*, and *Comm-Asym* are treatment dummies (the baseline category is *NoComm-Sym*). Standard errors adjusted for clustering at the session level in parantheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 7: Use of Communication under Symmetric Information

Symmetric Information	Rigid	Flexible
Overall use of communication		
Activation among all pairs	0.77	
Exchange among all pairs	0.70	
Activation among pairs with contract	0.76	0.94
Exchange among pairs with contract	0.69	0.90
Initiation of communication		
Seller initiation among all pairs	0.71	
Seller initiation among pairs with contracts	0.64	0.72
Blocking communication		
Blocked among all no-comm pairs	0.17	
Blocked among no-comm pairs with contracts	0.28	
Blocked by buyer among blocked	1.00	
Blocked by buyer among blocked with contract	1.00	1.00

Notes: The table reports indicators for communication use in the treatments with symmetric information (NoComm-Sym and Comm-Sym).

Table 8: Content of Messages under Symmetric Information

	ExpM	DamC	InfC	InfP	QuaP	ShaT	HigA	#obs
Pre-contract Conversations	0.02	-	0.67	0.62	0.51	0.02	-	931
Rigid Contracts	-	0.26	-	-	-	-	-	139
Flexible Contracts	-	0.33	-	0.91	0.76	0.09	-	534
Krippendorff's alpha	0.29	0.83	0.88	0.76	0.85	0.73	-	522

Table 9: Not Communicating vs. Communicating Pairs in Comm-Sym

	Not communicating pairs				Communicating pairs			
Contract	Rigid		Flexible		Rigid		Flexible	
State	Good	Bad	Good	Bad	Good	Bad	Good	Bad
Price	42.4	-	46.7	95.0	40.6	-	62.2	95.0
Shading	0.10	-	0.37	0.00	0.19	-	0.16	0.03
Auction Outcome	42.4		42.6		40.7		36.4	
Realized	1.00	0.00	1.00	1.00	1.00	0.00	1.00	1.00
Profit Buyer	93.8	10.0	78.4	45.0	91.8	10.0	71.5	43.7
	86.5		73.2		77.7		66.8	
Profit Seller	21.9	10.0	24.9	15.0	19.6	10.0	41.4	14.8
	20.9		23.3		18.0		36.9	
Surplus	115.7	20.0	103.3	60.0	111.4	20.0	112.9	58.6
	107.4		96.6		95.6		103.7	
Share of contracts	0.59		0.41		0.21		0.79	

Notes: The table compares outcomes in rigid and flexible contracts of not communicating (left) vs. communicating pairs (right) in the Comm-Sym treatment. *Price* is the average final price paid by the buyer to the seller. *Shading* is the shading rate (relative frequency with which the sellers pick low quality). *Auction outcome* is the fixed price (rigid contracts) or the lower bound of the price range (flexible contracts) determined in the competitive auction (irrespective of whether trade eventually occurred or not). *Realized* is the frequency with which trade took place. *Profit Buyer* and *Profit Seller* are average profits of the trading parties and *Surplus* is the sum of these payoffs.

Table 10: Impact of Communication on Outcomes under Asymmetric Information

	No Communication				Communication			
Contract	Rigid		Flexible		Rigid		Flexible	
State	Good	Bad	Good	Bad	Good	Bad	Good	Bad
Price	39.7	-	53.6	95.0	43.0	-	60.0	95.0
Shading	0.10	-	0.22	0.06	0.12	-	0.17	0.02
Auction Outcome	39.9		37.7		43.1		38.3	
Realized	1.00	0.00	1.00	0.33	1.00	0.00	1.00	0.41
Profit Buyer	96.1	10.0	78.0	20.7	92.1	10.0	73.0	24.1
	76.3		66.5		78.1		63.0	
	70.1				68.6			
Profit Seller	19.2	10.0	32.5	11.5	22.4	10.0	39.2	12.0
	17.1		28.3		20.3		33.6	
	24.1				28.7			
Surplus	115.3	20.0	110.5	32.3	114.4	20.0	112.2	36.1
	93.3		94.8		98.4		96.7	
	94.2				97.3			
Contract Choice	0.37		0.63		0.37		0.63	

Notes: The table summarizes the main outcomes in rigid and flexible contracts in the two treatments with asymmetric information (NoComm-Asym (left) and Comm-Asym (right)). *Price* is the average final price paid by the buyer to the seller. *Shading* is the shading rate (relative frequency with which the sellers pick low quality). *Auction outcome* is the fixed price (rigid contracts) or the lower bound of the price range (flexible contracts) determined in the competitive auction (irrespective of whether trade eventually occurred or not). *Realized* is the frequency with which trade took place. *Profit Buyer* and *Profit Seller* are average profits of the trading parties and *Surplus* is the sum of these payoffs.

Table 11: Use of Communication under Asymmetric Information

Asymmetric Information	Rigid	Flexible
Overall use of communication		
Activation among all pairs	0.51	
Exchange among all pairs	0.42	
Activation among pairs with contract	0.52	0.75
Exchange among pairs with contract	0.41	0.69
Initiation of communication		
Seller initiation among all pairs	0.70	
Seller initiation among pairs with contracts	0.61	0.72
Blocking communication		
Blocked among all no-comm pairs	0.17	
Blocked among no-comm pairs with contracts	0.24	
Blocked by buyer among blocked	0.83	
Blocked by buyer among blocked with contract	0.80	0.91

Notes: The table reports indicators for communication use in the treatments with asymmetric information (NoComm-Asym and Comm-As ym).

Table 12: Content of Messages under Asymmetric Information

	ExpM	DamC	InfC	InfP	QuaP	ShaT	HigA	#obs
Pre-contract Conversations	0.02	-	0.67	0.62	0.51	0.02	-	931
Rigid Contracts	-	0.26	-	-	-	-	-	139
Flexible Contracts	-	0.33	-	0.91	0.76	0.09	-	534
Krippendorff's alpha	0.29	0.83	0.88	0.76	0.85	0.73	-	522