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## To Choose or Not to Choose: Contracts, Reference Points, Reciprocity, and Signaling\*

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### Abstract

Hart and Moore (2008) argue that varying degrees of flexibility in contracts induce differing reference points and aspiration levels for parties' shares of a transaction's total surplus. As a consequence, a trade-off between adaptational flexibility and the prevention of distributional conflicts emerges. In a recent paper, Fehr et al. (2011) analyze a buyer-seller-relationship with incomplete contracts and ex ante uncertainty regarding the sellers' cost level to test these effects. We re-run their experiment and introduce another treatment with exogenously determined contract types. Like FHZ we find reference point effects in both treatments. However, uncooperative shading behavior in our treatments differs substantially from that described in FHZ. Furthermore, it makes a significant difference whether contract types are determined by buyers or determined exogenously. We explain this by introducing two further effects, a reciprocity effect and a signaling effect.

*Keywords:* contracts, reference points, experiment

JEL Classification: C91, D03, D23

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## 1 Introduction

Hart and Moore (2008) provide a new behavioral theory for the emergence of flexible vs. rigid contracts. They assume that contractual performance depends on whether the trading parties are able to realize the profits they believe themselves to be entitled to. If they are unable to derive this amount of profit, they feel aggrieved and are inclined to punish their trading partners by not delivering consummate performance. In doing so, they generate a welfare loss. Hart and Moore (2008) argue that through the irrevocable fixing of prices under competitive terms, buyers' and sellers' aspiration levels become compatible so that neither aggrievement of any trading partner nor the delivery of bad quality ("perfunctory performance" or "shading") will occur.<sup>1</sup> In this way, concluding contracts with rigid terms serves to reduce inefficiency.

However, making rigid contracts has its own drawback. Irrevocable fixing of the terms of a contract might make it impossible to adapt to unforeseen events. This decreases welfare. Consequently, there exists a trade-off between being able to effectively adapt to new circumstances and the ability to avoid distributional conflicts. By extending this simple logic, Hart and Moore provide a basis for long-term contracts in the absence of non-contractable investments and an explanation of rigid employment contracts.

Fehr et al. (2011) present a first experimental investigation of Hart and Moore's theory. At the first stage, buyers determine whether to offer a rigid or a flexible contract. Next, contracts are auctioned off. The auction design ensures a competitive equilibrium so that sellers accept minimal prices for their products. In rigid contracts, these auction prices are irrevocable and identical to final prices. In unfavorable circumstances determined by a chance move, these prices do not allow the trade to be realized. According to Hart and Moore (2008), rigid contracts will ensure the delivery of high quality by the sellers. In contrast, flexible contracts always allow trading. The costs of flexible contracts consist of distributional conflicts that are induced by incompatible aspiration levels, i.e., subjective entitlement to shares of a total surplus, on the part of buyers and sellers. Buyers are allowed to increase prices above auction prices to appease sellers so that they do not provide low-quality products. At the final stage, sellers decide whether to provide normal or low quality. Note that a delivery of low quality increases the seller's costs so that no seller has a material incentive to make such a delivery.

By and large, the results of Fehr et al. (2011) are in line with those of Hart and Moore (2008). There is less shading in rigid contracts, although sellers use their potential for increasing prices. This definitely supports the view of rigid contract prices as reference points. Two robustness checks also support Hart and Moore (2008): (a) reduc-

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<sup>1</sup> Hart (2009), Hart and Holmstrom (2011), and Hart (2011) developed a theory of the firm that based on the contracts as reference point approach.

ing the range of price increases that is feasible in flexible contracts decreases the provision of low quality (perfunctory performance); and (b) eliminating the competitive determination of (auction) prices induces a significant increase in the provision of low quality (Fehr et al. (2009)).

Fehr et al. (2011) admit that two features of their experimental results are quite surprising. First, they find very little perfunctory performance with rigid contracts. This is surprising because payoffs are highly asymmetric in these cases and standard measures of fairness or inequity aversion suggest much more perfunctory performance. Furthermore, the act of choosing rigid contracts itself can be interpreted as an uncooperative behavior that deserves punishment via the delivery of low quality. Second, the unexpectedness of this finding is increased because there is much more perfunctory performance in flexible contractual relations even though the payoff asymmetry is significantly reduced by buyers' voluntary price increases. Fehr et al. (2011) conjecture that this can be explained by a "new behavioral force": "ex ante competition legitimizes the terms of the contract, and aggrievement occurs mainly about outcomes within the contract and not about the contract itself." (Fehr et al. (2011), p. 493) In our judgment, this explanation seems rather artificial. Do sellers really make such a neat distinction between "within the contract" and "the contract itself" while at the same time not considering that the buyers' choice of rigid contracts causes their profits to decrease significantly? Furthermore, the choice of contract types is by no means determined under competitive conditions.

This is where our analysis begins. Our motivation for conducting our own investigation is based upon two open questions: (1) why do sellers not punish buyers for choosing rigid contracts? and (2) why do sellers not appreciate buyers' voluntary price increases in flexible contracts? To test whether Fehr et al.'s interpretation of the data is appropriate, we replicate FHZ's main treatment and introduce a new treatment. In this new treatment, contract types are not determined by the players. If FHZ are right, this change in experimental design should not have an impact on subjects' behavior. If, however, the players' behavior changes significantly, there must be other forces at work than just reference point effects.

Our main findings are as follows: (a) in the replication treatment with endogenous contract types, we find many more cases of delivery of low quality (perfunctory performance) than reported in FHZ; and (b) in the case of *exogenously* determined rigid contracts, perfunctory performance decreases substantially. Our interpretation of (a) and (b) is that the subjects in our experiment do indeed punish buyers for *choosing* rigid contracts. We call this a reciprocity effect. Additionally, (c) there is significantly less perfunctory performance if flexible contracts are determined exogenously than if the buyers actively choose flexible contracts. Our interpretation of this phenomenon is that players' aspiration levels depend not only on contract types but also on the signal that buyers send by choosing flexible contracts, which are more favorable to sellers. Sellers

then expect their trading partners to be more cooperative so that sellers' aspiration levels increase with respect to their share of the surplus. This will, in turn, make sellers more inclined to provide perfunctory performance if buyers turn out to be less generous than expected. We call this the signaling effect. Nevertheless, we find (d) evidence for the existence of a reference point effect in treatments with both endogenous and exogenous determination of contract types.

The paper is structured as follows. In Section 2, we describe our experiment's design and provide details regarding the procedures used. In Section 3, we present the behavioral predictions. Section 4 contains our results and the relevant discussion. Section 5 concludes.

## 2 Experimental Design

In this section, we present our experimental design and procedures. We consider a relationship between a buyer and a seller who are interacting during a two-period relationship. At date 0, they conclude an incomplete contract for the trade of one unit of a widget. The incompleteness of the contract is due to the possibility that the trade may not be feasible on date 1. The feasibility depends on the nature of the contract and on the ex ante unknown state of nature. The relationship's dynamic resembles the "fundamental transformation" described by Williamson (1985). In such a setting, transaction partners begin with a competitive market structure that after some events, e.g., a specific investment, changes into a one-sided or bilateral monopoly. In all treatments, we have two different kinds of contracts, i.e., rigid and flexible contracts, and this brings our experiment in line with the model proposed by Hart and Moore (2008).

We implemented two different treatments, an endogenous contract treatment (EndCT) and an exogenous contract treatment (ExCT). The EndCT is closely related to the design of Fehr et al. (2011). In our ExCT we abolish the buyers' ability to choose between contract types. Each session consists of 15 such periods. Figure 2 (given in the appendix) shows the structure of each period. To facilitate subjects' understanding of the experiments, we subdivided each period into seven sequential stages:

### ***Stage 1 – Formation of groups:***

To avoid reputational effects, buyers and sellers were randomly divided into interaction groups of two sellers and two buyers each at the beginning of each period.

### ***Stage 2 – Determination of contract types:***

The determination of contract types varied between the two treatments. In the EndCT, buyers decide whether to choose the rigid or the flexible contract design. In the ExCT, the contract design is exogenously given to the participants. The difference between the designs relates to the process of determining the final product price. In rigid contracts, the auction price (Stage 3) is binding for buyers and sellers. Furthermore, if

the state of nature (Stage 4) turns out to be bad, these binding contracts do not allow for trade to be accomplished. In flexible contracts, buyers may increase product prices above the level given by the auction if they wish to do so, and trade is always feasible. Table 1 shows the intervals of feasible final prices with respect to contract types and states of nature.

**Stage 3 – Sellers compete for contracts in clock auctions:**

After the two buyers in a group have chosen their contract types, contracts are auctioned off to the sellers. Just like FHZ, we implemented an inverse clock auction with a starting price of 35 that is increased by one point each second. The auction ends either when the upper limit of 75 is reached or if one of the sellers accepts the current auction price by clicking a button on the computer screen. The first seller accepting the price gains the contract and enters into the bilateral contract performance stages. As described above, the final price either is fixed at the level of the auction price (rigid contracts) or may voluntarily be increased by the buyer. Sellers who do not gain a contract realize an outside option payment of 10 points.

To design a truly competitive auction, the supply of widgets was made twice as large as the demand. More precisely, each seller is able to produce up to two widgets per period, while buyers can buy just one widget. This means that any seller may serve both buyers, while any buyer can only buy from one seller. Consequently, there is an excess supply, which creates a highly competitive auction environment. Unlike in FHZ, the auctions for the two possible contracts in each group are conducted simultaneously. The auction boxes are randomly placed next to each other on the computer screen. Sellers are free to engage in any of the auctions as long as none of them has accepted an auction price for the auction in question. If one of the contract prices is accepted, the corresponding auction is immediately finished.

Table 1: Intervals of Feasible Final Prices

Contract type	State of nature	
	Good	Bad
Rigid contract	Auction price	No trade
Flexible contract	[Auction price, 140]	[95, 140]

Note: The auction price was determined by an inverse clock auction between the two sellers in one group. It could range from 35 to 75.

**Stage 4 – Determination of the state of nature:**

After the sellers and buyers have concluded their contracts, they are informed about the state of nature. This state determines the parameters of the remaining part of the period. First, it has an impact on sellers’ costs (see Table 2). In bad states, sellers’ costs

increase by 60 points. In addition, minimum final prices are also increased to 95. Second, the state of nature determines whether sellers and buyers can trade at all. If buyers have chosen rigid contracts and a bad state emerges, trade becomes impossible. In all other cases, trade will be accomplished (see Table 1). Good states occur with a probability of 80 percent and bad states with a probability of 20 percent. In the no-trade case, buyers and sellers get an outside option of 10 points each.

Table 2: Experimental Parameter

State of nature	Good (prob = 0.8)		Bad (prob = 0.2)	
	normal	low	normal	low
Seller's cost	20	25	80	85
Buyer's value	140	100	140	100

**Stage 5 – Determination of the final price:**

The process of determining final prices depends on the chosen contract type. In the case of rigid contracts, participants do not have to make any decisions because the final price is given by the auction price. With flexible contracts, buyers can voluntarily increase final prices above the auction price (or above 95 in bad states), up to a maximum of 140 (see Table 1).

**Stage 6 – Sellers choose quality:**

If trade takes place, sellers have to determine product quality, which can be either low or normal. Irrespective of the state of nature, choosing low quality instead of normal increases sellers' costs by 5 points and decreases buyers' value by 40 points (see Table 2).

**Stage 7 – Determination of profits:**

At the end of each period, profits are displayed to buyers and sellers. The payoffs were calculated as follows:

Seller profits:  $\pi_S = \text{price} - \text{costs}$

Buyer profits:  $\pi_B = \text{value} - \text{price}$

To compare our results with those of FHZ, it is necessary to summarize the ways in which our EndCT differs from the experiment of FHZ. First, we used different instructions, though they were of course somewhat similar to those of FHZ.<sup>2</sup> As mentioned, we used simultaneous auctions (Stage 3) instead of sequential auctions because we wanted to ascertain which contract type is preferred by the sellers. Finally, FHZ provided buyers

<sup>2</sup> Instructions are available upon request.

with aggregate information about average buyer profits as an additional eighth stage of each period. Average profits were given separately for the two contract types over all past periods. Though providing this information facilitates learning, it also weakens the independency of individual decisions and fosters contagion effects. We felt that next to the speed of the learning process, it might have an impact on the direction of learning.

All sessions were conducted in December 2008 and January 2009. We conducted two sessions for each of the two treatments with 20 subjects each (10 buyers and 10 sellers). Subjects were students from the Clausthal University of Technology with majors such as Business Administration or Industrial Engineering. To make them familiar with our experimental design, we started every session with two training periods that were not remunerated. In both treatments, 45 experimental currency units (points) corresponded to one Euro. In addition, each participant received a show-up fee of 5 Euro. On average, subjects earned 18.28 EUR (about 25.41 USD at the time of the experiment). A session lasted for about one and a half hours. The experiments were computerized using the software z-Tree (Fischbacher 2007).

### 3 Hypotheses

The main motivation for carrying out our experiment is that we presume that the process of determining contract types has an impact on subjects' behavior. Different modes of determining contract types may lead to different modes of behavior. In particular, sellers may be able to learn that rigid contracts decrease their expected profits and cause an unfair distribution of profits. Sellers realizing this will be inclined to interpret the choice of rigid contracts as unfriendly behavior that deserves punishment via provision of low quality. On the other hand, choosing of flexible contracts may be understood as a signal of cooperative behavior. Such a signal will increase sellers' expectations regarding profits. Assuming that this will increase sellers' aspiration levels, low price increments will not meet sellers' aspiration levels and provoke shading. In summary, according to our considerations, the feasibility of actively choosing contract types increases the inclination to provide low quality. Consequently, replacing the active choice of contract types with a chance move will lead to less shading in both types of contractual relationships. Keeping this in mind, we can now present our central hypotheses.

After group formation, the second stage in each period consists of determining contract types. In the EndCT, we expect the same pattern of decisions as reported by Fehr et al. (2011). Because there is no choice between contract types in the ExCT, it does not make sense to provide any behavioral hypotheses regarding this decision.

**HYPOTHESIS 1 (Contract Choice):**

*In the endogenous contract treatment, subjects choose rigid contracts in about 50 percent of cases and flexible contracts in the remaining 50 percent of cases.*



At Stage 2 of each period, contracts are auctioned off. Since there is always an excess supply, equilibrium prices are equal to minimum prices. Following FHZ, we expect to see deviations in early rounds due to subjects' learning. In contrast to FHZ, we implemented simultaneous auctions for both buyers' contracts within one group. This renders it possible to analyze which kind of contract sellers prefer. In FHZ, sellers' profits in flexible contracts are significantly higher than in rigid contracts. Expecting a similar pattern of profits, sellers will prefer flexible contracts. In groups in which there is one auction for rigid contracts and one auction for flexible contracts, sellers will thus try to get a flexible contract first and only afterwards try to get the remaining rigid contract. Due to the nature of the clock auction, prices for rigid and flexible contracts will differ in these cases.

**HYPOTHESIS 2 (Auction Prices):**

- a) *In both treatments, auction prices converge toward the competitive equilibrium,  $p_A = 35$ .*
- b) *On average, prices for flexible contracts are lower than prices for rigid contracts.*

While rigid contracts leave no room for price adjustments, flexible contracts allow buyers to increase prices within the price range above the competitive lower price bound. This opportunity may affect the sellers' shading decision so that increasing the price may encourage sellers not to provide low quality. This price decision at date 1 (Stage 5) is somewhat similar to an ultimatum game [Güth, Schmittberger, Schwarze (1982)] in which a proposer makes an offer regarding how to share an amount of money with the responder. The responder then decides whether to accept the proposal or reject it. In this type of game, rejections result in a payoff of zero. In our experiment, buyers act as a kind of proposer by offering a particular share of the total surplus to the seller. After this, the seller "accepts" the offer by providing normal quality or "rejects" it by providing low quality. Unlike in the ultimatum game, the seller can lower the buyer's profit by only 40 points in our experiment, and his costs increase by only 5 points. In line with Forsythe et al. (1994), we expect that buyers will pay prices significantly higher than the lower price bound to avoid shading.

FHZ show that buyers are indeed willing to pay significant price increments associated with flexible contracts. Accordingly, we expected to find a similar pattern in the EndCT. However, behavior related to the ExCT may differ. Being able to choose between contract types and choosing flexible contracts may have an impact on sellers' aspiration levels in the EndCT that is absent from the ExCT. In particular, we presume that a buyer choosing flexible contracts signals a preference for cooperative and fair behavior. Thus, sellers' expectations rise. This signaling effect does not exist in ExCT because sellers do not choose their contract types. Consequently, sellers' aspiration levels remain smaller so that buyers need to pay smaller amounts of money to prevent sellers from shading.

**HYPOTHESIS 3 (Price Increment):**

- a) *In both treatments, buyers pay prices that are higher than the lower price bound in flexible contracts and consequently price increments above zero.*
- b) *In the exogenous treatment, a lower aspiration level on the part of the sellers causes lower price increments or higher average quality.*

At Stage 6 of each period, the sellers choose whether to provide low or normal quality. This decision is at the core of the papers by Hart and Moore (2008) and FHZ. According to the reference point hypothesis, rigid contracts leaving no room for further adaptations provide a reference point on which both parties agree. Although profits may be highly asymmetric, the existence of a reference point prevents shading. The evidence in FHZ confirms that there is less shading in rigid contracts than in flexible contracts.

Assuming that the process of determining contract types has an impact on subjects' behavior, we conjecture that other effects besides the reference point effect must be at work. We argue that the possibility of choosing between contract types increases shading in both rigid and flexible contracts. It remains unclear, however, whether this treatment effect is larger in rigid contracts or in flexible contracts. If shading due to the choice of rigid contracts is smaller than shading due to unfulfilled expectations from flexible contracts, Fehr et al.'s results can be explained without any mention of reference point effects. Comparing shading in both treatments may clarify the nature of subjects' behavior. According to the theory of contracts as reference points, the magnitude of the reference point effects does not depend on the process of determining the contract type; instead, it only depends on the contract type itself. Consequently, there will be no differences in shading between the treatments. If, in contrast, shading decreases to zero in the ExCT, then the reference point hypothesis must be rejected. Finally, if shading in the ExCT is smaller than in the EndCT and if shading under flexible contracts is greater than under rigid contracts (ExCT), then all effects (reference point effects, punishment effects/reciprocity based on choosing rigid contracts and signaling effects based on choosing flexible contracts) are confirmed. This leads us to two alternative hypotheses:

**HYPOTHESIS 4a** (Pure Reference Points):

*In both treatments, shading will be close to what it was in FHZ, i.e., subjects will provide low quality in about*

- a. *6 percent of cases (rigid contracts)*
- b. *25 percent of cases (good states in flexible contracts)*
- c. *30 percent of cases (bad states in flexible contracts).*

Hypothesis 4a is in perfect accordance with Hart and Moore (2008) and FHZ. Our alternative hypothesis refers to the existence of reciprocity and signaling effects:

**HYPOTHESIS 4b** (Reciprocity and Signaling Effects):

- (i) *In the endogenous contract treatment, shading will be close to what it was in FHZ, i.e., subjects will provide low quality in*
  - a. *6 percent of cases (rigid contracts)*

- b. 25 percent of cases (good states in flexible contracts)
- c. 30 percent of cases (bad states in flexible contracts).
- (ii) In the exogenous contract treatment, shading will be lower than in the endogenous contract treatment
  - d. If shading decreases to zero, there are no reference point effects.
  - e. If shading remains above zero and if there is more shading in flexible than in rigid contracts, there are reference point effects, reciprocity effects and signaling effects.

## 4 Results

In this section we present and discuss our results. In the EndCT, we find surprisingly large deviations from the results presented in FHZ. Buyers choose flexible contracts more often and pay smaller price increments. Sellers provide low quality more often than in FHZ. This difference in shading is largest with respect to rigid contracts. Our new treatment with contract determination by chance moves shows a large shift in behavior. There is less shading associated with both contract types. This supports our hypothesis that the results presented in FHZ are also driven by factors other than pure reference point effects. We first present the results and then provide an explanation. Our aggregate results are presented in Table 8.

Insert Table 8 here

In FHZ each contract type is chosen in 50 percent of the cases. Table 8 shows that in our sessions with endogenous contracts, buyers reveal a clear preference for flexible contracts; 72.3 percent of the contracts were flexible. Taking into account that average buyers' profits in rigid contracts (65.69) are (insignificantly) larger than in flexible contracts (61.2), this result becomes even more remarkable. The more or less equal distribution of contract types in the ExCT is irrelevant here because contracts have not been chosen by buyers but have rather been determined exogenously.

### **RESULT 1** (Contract Choice):

*Although average buyers' profits in flexible contracts are smaller than their profits in rigid contracts they choose flexible contracts in more than two out of three cases.*

Obviously, subjects' behavior in our experiment is different from subjects' behavior in FHZ. We identify two possible explanations for this. (1) We, unlike FHZ, did not provide subjects with any statistical information about the aggregate profitability of rigid and flexible contracts in the transactions of other players. Due to this lack of information, subjects may have been unable to identify the more profitable contract type. (2) We had a different subject pool than FHZ. FHZ excluded all students of economics and

psychology, whereas more than 75 percent of our subjects study business administration or industrial engineering. Consequently, their education may have had an impact on their behavior in the laboratory. It is somewhat surprising, however, that these economically trained participants favored the less profitable but (with respect to the distribution of profits) fairer contract type.

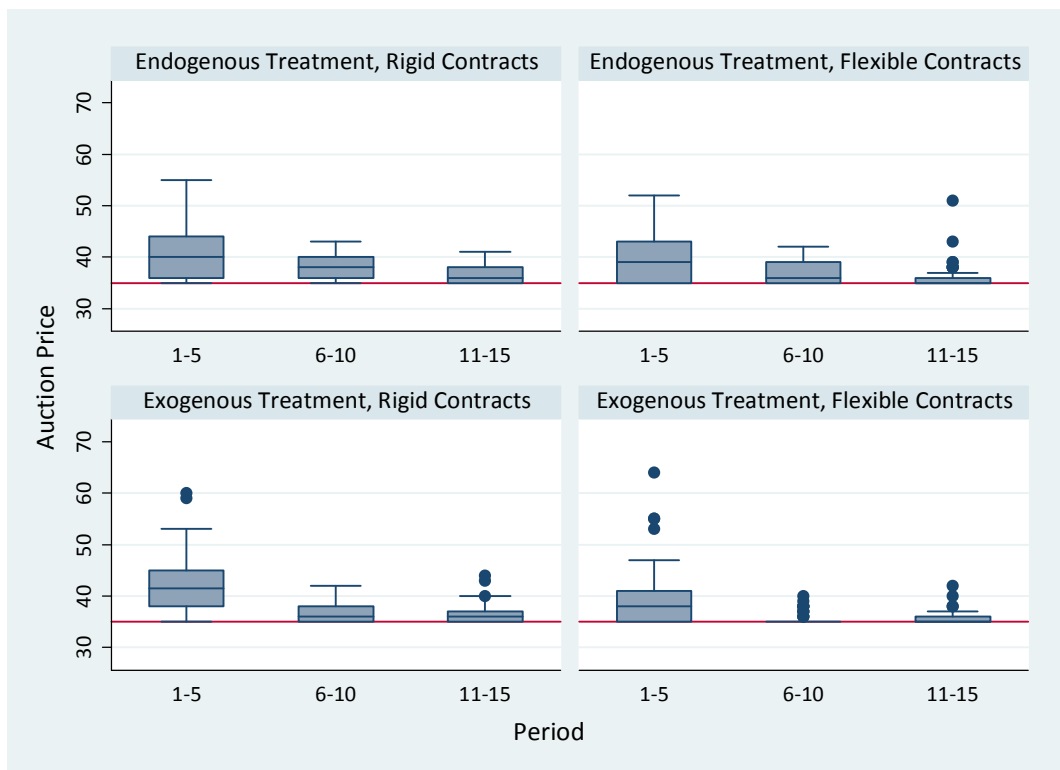
After the buyers had chosen their contract types, all contracts were auctioned off to the sellers. The results of the auctions are close to the results in FHZ and close to our expectations.

**RESULT 2 (Auction Prices):**

- (a) *Prices converge to the equilibrium value  $p = 35$ .*
- (b) *Prices for flexible contracts are lower than those for rigid contracts.*

Figure 1 shows box plots for auction prices in groups of periods (1-5, 6-10, 11-15). It can easily be seen that the auction prices in the first periods are well above 35 and converge over time to the equilibrium price. In the final five periods, mean auction prices in EndCT and ExCT are 36.07 and 35.99, respectively. In contrast to FHZ, we held simultaneous auctions of both contracts in each period and group. Consequently, in accepting one contract, subjects lost time and could only accept the second contract after the corresponding time lag. This and the normal reaction time of participants explains most of the divergence of prices from equilibrium values.

Figure 1: Auction Prices



The simultaneity of auctions includes another advantage. Excess supply in markets for contracts induces intense competition between sellers so that they will immediately accept contracts in equilibrium. If sellers prefer one type of contract to the other, we should find that sellers first try to get this contract type and only subsequently accept the other one. This implies that prices for preferred contracts will be lower than prices for the other contracts.

Comparing sellers' profits shows that in flexible contracts, sellers' profits are substantially larger: sellers' mean profits under flexible contracts are 22.44 (endogenous contracts) and 24.94 (exogenous contracts); under rigid contracts, they earn only 15.10 (endogenous contracts) and 15.91 (exogenous contracts). Thus, we expect auction prices to be lower for flexible contracts. Table 8 shows that part (b) of Hypothesis 2 is also supported. In both treatments, auction prices for flexible contracts are lower on average, and the difference is statistically significant at the 5 percent level (signed rank test of individual means).

**RESULT 3 (Price increment):**

- (a) *In both treatments, the mean price increments are above zero.*
- (b) *Mean price increments do not differ between treatments.*

There are two different ways to define the price increment. First, the price increment (hereafter p35) consists of the additional points above the minimum feasible price of 35 in the clock auction.<sup>3</sup> However, this definition does not take into account that the contract / auction price serves as a reference point in principle. Consequently, we define the price increment as the difference between the final price (chosen by the buyer at date 1) and the auction price in good states of nature or 95 in bad states of nature. Thus, the price increment in rigid contracts is always zero. As long as result 2 holds, most of the difference between the two definitions of the price increment will disappear in the last periods of the experiment.

In our post-experimental questionnaire, we asked the sellers to reveal their minimum price increments required for abstaining from shading under conditions of a flexible contract, a good state of nature and an auction price of 35. On average, in the EndCT case, the sellers claim 20.25 points. In the ExCT case, we observe only a mean price increment of 10.95 points. Thus, in accord with our conjectures, the removal of buyers' responsibility for contract choice reduces sellers' aspiration levels significantly (one-sided rank sum test  $p < 0.01$ ). However, changing treatments does not have an impact on buyers' willingness to pay. In the questionnaire, we also asked how much buyers were willing to pay to foreclose shading under conditions of flexible contracts, good states of

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<sup>3</sup> FHZ use this definition.

nature and auction prices of 35. On average, buyers were willing to pay up to 14.35 in the EndCT and 14.25 in the ExCT.

Table 3 confirms our post-experimental observations. It shows the mean price increment with respect to the two different treatments. None of the differences between the treatments is statistically significant (one-sided rank sum test with subject means,  $p > 0.10$ ). The price increments are, by and large, the same. Accordingly, buyers' behavior with respect to price increments does not appear to depend on the endogeneity or exogeneity of the contract types.

Table 3: Mean Price Increments in Both Treatments

	State of nature		
	Bad	Good	Total
<i>Fehr et al. (2011)</i>	3.4	10.9	---
EndCT	2.80 (4.154)	10.04 (12.789)	7.51 (11.135)
ExCT	3.87 (4.932)	11.12 (13.587)	9.20 (12.326)

Notes: Standard deviations are in parentheses. A one-sided rank sum test with subject means shows that none of the differences between the treatments is statistically significant ( $p > 0.10$ ).

The decision of whether to provide normal or low quality is at the core of our experiment. Following Hart and Moore (2008), we refer to the provision of low quality as “shading”. Our main research question is whether the difference in shading behavior with respect to contract types may not only be interpreted as a reference point effect, but also as reciprocity and signaling effects. If behavior in the ExCT is significantly different from behavior in the EndCT, there must exist some additional effects that FHZ subsume under reference point effects.

Table 4 summarizes the shading behavior in our experiment. The first distinctive feature of our results is that we find much more shading in the EndCT than FHZ do. In particular, there is more shading in rigid contracts.

Table 4: Shading Behavior  
with Respect to Treatment, Contract Type, and State of Nature

	Contracts types and states of nature			
	Rigid		Flexible	
	Bad	Good	Bad	Good
EndCT	---	0.32	0.37	0.33
(FHZ)	---	(0.06)	(0.30)	(0.25)
ExCT	---	0.15	0.08	0.22

Note: Numbers are relative frequencies of shading. Numbers in parentheses represent the corresponding relative frequencies of shading in FHZ.

Even more importantly, there are only small differences in shading between rigid and flexible contracts. None of these small differences is statistically significant (signed rank test of subject means). In the EndCT, shading in rigid contracts and good states is just slightly smaller than in flexible contracts and good states. Compared to the FHZ results, reference point effects seem to be rather small for our sessions.

Things are somewhat different in the ExCT. Compared to endogenous contracts, shading is substantially and significantly smaller in all combinations of states and contract types (one-sided rank sum test;  $p < 0.05$ ). Furthermore, in good states, there is less shading in rigid contracts than in flexible contracts. Our results clearly contradict Hypothesis 4a (pure reference points) and support Hypothesis 4b.

**RESULT 4:**

- (i) *In the endogenous contract treatment, shading behavior is not close to what was evidenced in FHZ. Subjects provide low quality in*
  - a. *32 percent of cases (rigid contracts)*
  - b. *33 percent of cases (good states in flexible contracts)*
  - c. *37 percent of cases (bad states in flexible contracts).*
- (ii) *In the exogenous contract treatment, shading is lower than in the endogenous contract treatment. Furthermore, shading remains above zero, and there is more shading in flexible than in rigid contracts.*

It is remarkable how much more shading we find in rigid contracts when compared to the results of FHZ. This might raise doubts concerning the validity of the reference point hypothesis. However, it has to be taken into account that prices under flexible contracts are higher than those under rigid contracts so that there is less of an incentive for sellers to shade. In Table 5, we present relative frequencies of shading for different price intervals. To compare prices in different states, price increments (p35) are defined as

final prices minus minimal feasible prices, i.e., prices minus 35 in good states or prices minus 95 in bad states. Table 5 shows that for all but one interval, shading in rigid contracts and good states is less than shading in flexible contracts and good states. This supports the reference-point-effect hypothesis (RPE).

Table 5: Shading Under Different Price Intervals

Price increments (p35)	Endogenous Contracts				Exogenous Contracts			
	Rigid		Flexible		Rigid		Flexible	
	Bad	Good	Bad	Good	Bad	Good	Bad	Good
p35 = 0		.333	.488	.409	.091	.125	.333	
0 < p35 ≤ 5		.313	.200	.404	.191	.000	.308	
5 < p35 ≤ 10		.385	.100	.412	.231	.167	.071	
10 < p35 ≤ 15		.000	.667	.188	.000	.000	.200	
15 < p35		.000		.205	.000		.156	

Note: Numbers are relative frequencies of shading.

Our results indicate that it makes a difference whether contracts are determined endogenously or exogenously. Endogenously determined rigid contracts clearly result in more shading than exogenously determined contracts. When sellers had to decide whether to shade or not, the only difference between the two treatments was that buyers had consciously determined the contract type so that they were responsible for it. Our interpretation of the increase in shading is thus that sellers punished buyers for selecting the incorrect type of contract. This, in turn, is nothing more than negative reciprocity (RecE) and affects shading behavior in the opposite direction of reference point effects.

The endogenous choice of a contract type increases shading in flexible contracts, as well. Because we regard a decision in favor of a flexible contract as a signal that increases the aspiration level of the seller, it would seem that low price increments disappoint sellers such that they are more inclined to punish buyers (SigE). Table 6 summarizes our theory about the three effects.



Table 6: Theoretical Effects

	Rigid Contracts	Flexible Contracts
Endogenous Contracts	RPE: –	RPE: +
	RecE: +	SigE: +
Exogenous Contracts	RPE: –	RPE: +

Note: RPE denotes the reference point effect, RecE the reciprocity effect and SigE the signaling effect. The signs “+” and “–” indicate that the corresponding effect increases (+) or decreases (–) shading.

According to Table 6, and as long as the reciprocity effect is not too large, shading is highest in the case of flexible and endogenous contracts and lowest in the case of rigid and exogenous contracts. The remaining two cases, rigid endogenous contracts and flexible exogenous contracts, are somewhere in between. It is ex ante unclear which of these two cases will have more shading. These hypotheses are supported by the subjects’ behavior as shown in Table 5.

To conduct a more rigorous test, we performed some econometric estimations of shading behavior. In our data set, shading is given by the binomial variable shading. It equals 1 in the case of shading and zero in case of normal quality. Final prices can be separated into auction prices (priceauc) and price increments (priceinc).<sup>4</sup> Table 6 shows that the reference point effect is the same for endogenous and exogenous contracts. It refers only to the choice of contract type. FlexC is the corresponding variable (1 for flexible contracts and zero for rigid contracts). The reciprocity effect applies only to rigid and endogenous contracts. The binomial variable endorigid covers this effect. This interactive variable is 1 for rigid contracts in the EndCT and zero otherwise. The signaling effect occurs only in flexible endogenous contracts. The corresponding variable (endoflex) equals 1 in these cases and zero otherwise. According to our theoretical considerations, shading increases in FlexC, endorigid and endoflex.

Table 7 shows the results of our estimations. The dependent variable in all regressions is shading. The first estimation in column 2 serves as our benchmark estimation.<sup>5</sup> Let us first look at the benchmark model, a random effects logit model with few control variables. Column 2 shows that the coefficients of FlexC, endorigid and endoflex are all significant at the 5-percent level. Their signs are all positive. Therefore, our results corroborate the existence of all three effects, i.e., the reference point effect, the reciprocity

<sup>4</sup> Priceinc must not be confused with p35 in Table 5.

<sup>5</sup> The qualitative results of our estimation do not depend on the method of estimation and the inclusion of further control variables like state of nature, sex, age, and period. We conducted probit estimations, population average estimations, pooled logit estimations and OLS estimations with similar results.

effect and the signaling effect. Furthermore, the coefficients of endorigid and endoflex are higher than the coefficient of FlexC, indicating that the signaling and reciprocity effects are as least as important as the reference point effect. The coefficient of priceinc is significantly less than zero, meaning that buyers can decrease the probability of shading by increasing the final price.

Table 7: Random Effect Logit Regressions and Social Preferences

Variable	Model I	Model II	Model III	Model IV	Model V	Model VI
FlexC	.819 (.031)	.828 (.031)	.767 (.039)	.744 (.047)	.642 (.067)	.756 (.045)
endorigid	1.11 (.046)	1.11 (.046)	1.113 (.044)	1.122 (.044)	1.127 (.043)	1.12 (.045)
endoflex	1.24 (.015)	1.24 (.016)	1.232 (.016)	1.22 (.017)	1.191 (.019)	1.219 (.017)
priceinc	-.0807 (.000)	-.087 (.012)	-.059 (.001)	-.060 (.003)	-.051 (.005)	-.070 (.041)
good state	.630 (.024)	.801 (.203)		.330 (.188)		.600 (.269)
reci_unfair		-.003 (.425)	.0099 (.035)			-.005 (.382)
ia_shade				.899 (.064)	1.157 (.012)	.911 (.062)
constant	-2.86 (.000)	-2.78 (.000)	-3.052 (.000)	-3.47 (.000)	-3.399 (.000)	-3.34 (.000)
N	525	525	525	525	525	525
LL	-249.3	-249.3	-249.7	-248.1	-248.5	-248.1
LL(0)	-280	-280	-280.1	-279	-279.3	-279
R <sup>2</sup> ; R <sup>2,ps</sup>	.110	.110	.109	.111	.110	.111

Notes: dependent variable, shading; p-values (one-sided test) in parentheses; N, number of observations; LL, log-likelihood.

Finally, we find significantly more shading in good states. This may be explained according to two factors. First, there is simply less scope for price increments in bad states (140 – 95) than in good states (140 – auction price  $\approx$  140 – 35). Consequently, comparatively modest price increments in bad states look more generous than do larger price increments in good states. Second, the distribution of payoffs is more unequal in good states than in bad states. For example, if the buyer chooses a price increment of 15 in bad states, the two players’ payoffs are identical. In good states, however, the same price increment induces highly unequal payoffs, i.e.,  $\pi_B = 90$  and  $\pi_S = 30$ .<sup>6</sup>

<sup>6</sup> Here we assume the auction price to be 35, the equilibrium price.

Thus far, our results are economically and statistically significant. We believe, however, that due to the highly asymmetric payoffs in our experiment, it is necessary to test whether additional variables characterizing social preferences or fairness preferences have an impact on our main results. We measure such social preferences in two variables. The first one, *reci\_unfair*, measures the difference between the buyer's and the seller's hypothetical profits in the case of higher buyer profit, assuming that the seller does not shade. Our second variable, *ia\_shade*, is a binomial variable with direct reference to the models of inequality aversion reported by Fehr and Schmidt (1999). Given the utility function of Fehr and Schmidt,

$$U_i = \pi_i - \alpha_i \max\{\pi_j - \pi_i, 0\} - \beta_i \max\{\pi_i - \pi_j, 0\},$$

and assuming that  $\alpha_i = \beta_i = 0.5$ , we calculated whether shading is utility-maximizing in the sense of Fehr and Schmidt.<sup>7</sup> The variable equals 1 whenever shading maximizes utility, and equals zero otherwise.

Table 7 also shows the results of these estimations. Model I is the benchmark model again. In Model II and Model IV, we simply add one of the new variables for social preferences. Model VI includes both variables. Model II and Model V substitute the corresponding social preference variable for the state variable.

The introduction of the new variables has hardly any impact on the coefficients of *FlexC*, *endorigid* and *endoflex*, i.e., the variables at the core of our paper. The magnitudes of the coefficients remain by and large unchanged and statistically significant. Again, the existence of reference point effects, reciprocity effects and signaling effects is confirmed. Likewise, there is no substantial effect on the coefficient of *priceinc*. In contrast, the coefficient of the state variable is highly sensitive to the introduction of the variables for social preferences. The coefficients of all three variables, i.e., *good\_state*, *reci\_unfair* and *ia\_shade*, are statistically significant at the five percent level when they are included exclusively. When they are jointly included with one other variable or both, only *ia\_shade* remains weakly significant (at the ten percent level). This sensitivity is due to the high degree of correlation between these variables and, in particular, between *good\_state* and *reci\_unfair* ( $\rho = .68$ ).

Summarizing the results of the regression analysis, we can state our final result.

**RESULT 5:**

*According to the results of panel regressions, we find that*

- *there is evidence for the existence of reference point effects, reciprocity effects and signaling effects;*
- *all three effects are of a similar order of magnitude;*

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<sup>7</sup> Because of the large payoff asymmetries in our experiment, we had to select rather low values for  $\alpha$  and  $\beta$ . Otherwise, inequality-averse players would shade in virtually all cases.

- *the results are robust with respect to the variables included and the estimation methods;*
- *the variables referring to distributional fairness, i.e., `reci_unfair` and `ia_shade`, contribute to the explanation of subjects' behavior.*

## 5 Conclusion

In this paper, we provide a second experimental test of Hart and Moore's (2008) behavioral theory of contracts. Hart and Moore's main message is that rigid contract terms and particularly rigid prices may serve as reference points that can prevent ex post inefficiencies caused by incompatible subjective entitlements. In this paper, we find results deviating significantly from those of the first test presented by Fehr et al. (2011). FHZ provide remarkable support for Hart and Moore (2008). However, they admit to find some other surprising results. In particular, they find no evidence of negative reciprocity due to buyers' uncooperative choices regarding contract types and surprisingly little remuneration for buyers' voluntary increases of contract prices. Because we regard their explanation as rather unconvincing, after having performed a replication treatment, we introduce a new treatment in which buyers can no longer determine contract types. In the new treatment, contract types are exogenously determined by the experimenter. According to Fehr et al.'s interpretation of their data, this change in experimental design should not have an impact on behavior. We find, however, that the new design results in a substantial change in behavior. Furthermore, subjects' behavior in replicating sessions differs significantly from the behavior of subjects in FHZ.

First, we find more shading than FHZ with respect to endogenously chosen rigid contracts. We regard this increased shading as the (negative) reciprocity effect that FHZ are surprised not to find: sellers punish buyers for choosing rigid contracts and decreasing sellers' payoffs. This effect is so large that shading in our sessions is approximately the same in endogenously rigid and endogenously flexible contracts.

Second, determining contract types exogenously, as we do in our new treatment, results in a decrease in shading of approximately 50 percent for both rigid and flexible contracts. Consequently, we find that it does make a large difference whether contract types are chosen by the players themselves, and that Fehr et al.'s interpretation of the data seems to be incomplete. The decrease in shading under rigid contracts can be explained by the omission of the reciprocity effect because buyers are no longer responsible for contract types. We interpret the decrease in shading with flexible contracts as the omission of a signaling effect. This signaling effect, which works in the case of endogenous contracts, stems from the possible interpretation of sellers that choosing of flexible contracts may signal more cooperative behavior on the part of buyers. This signal increases sellers' aspiration levels. At any rate, Fehr et al.'s conjecture that "aggravement

occurs mainly about outcomes within the contract and not about the contract itself' (Fehr et al. (2011), p. 497) is not supported by our data.

Third, we also find evidence for the existence of reference point effects. These effects are manifest in the smaller shading in rigid contracts when compared to flexible contracts, given final prices and treatments. Fourth, in our experiment, reference point effects are of a smaller magnitude than in FHZ. In particular, they are smaller than the treatment effects. Fifth, we find evidence for the relevance of social preferences and fairness considerations with respect to payoff asymmetries.

In summary, we find that it is not only contract types and their corresponding reference point effects that determine sellers' shading behavior, but also the process by which contract types are selected. In our experiment, sellers take into account buyers' behavior at all stages of the experimental game, while Fehr et al. (2011) find evidence only of the feasible price range that remains after the auction phase and may cause grievement and perfunctory performance.

Hart and Moore (2008) and FHZ emphasize that the existence of reference point effects is dependent on ex ante competition. According to both papers, prices do not serve as reference points without ex ante competition. However, the experimental design of FHZ establishes only one-sided competition and gives all market power to the buyers. There is no competition between buyers at all. We believe that this does not really correspond to the fundamental transformation as put forward by Williamson (1985). Therefore, a Double Auction instead of the seller auction might be a better test of Hart and Moore's theoretical approach; however, this must be left for future research.

Finally, in many experiments, we find that environments in which subjects have little or no information about trading partners' payoffs result in behavior that is closer to the standard economic approach. Because information about trading partners' payoffs is often highly incomplete in real life, it remains to be seen whether the actual experimental results also carry over to such situations. Again, this question must be left for future research.

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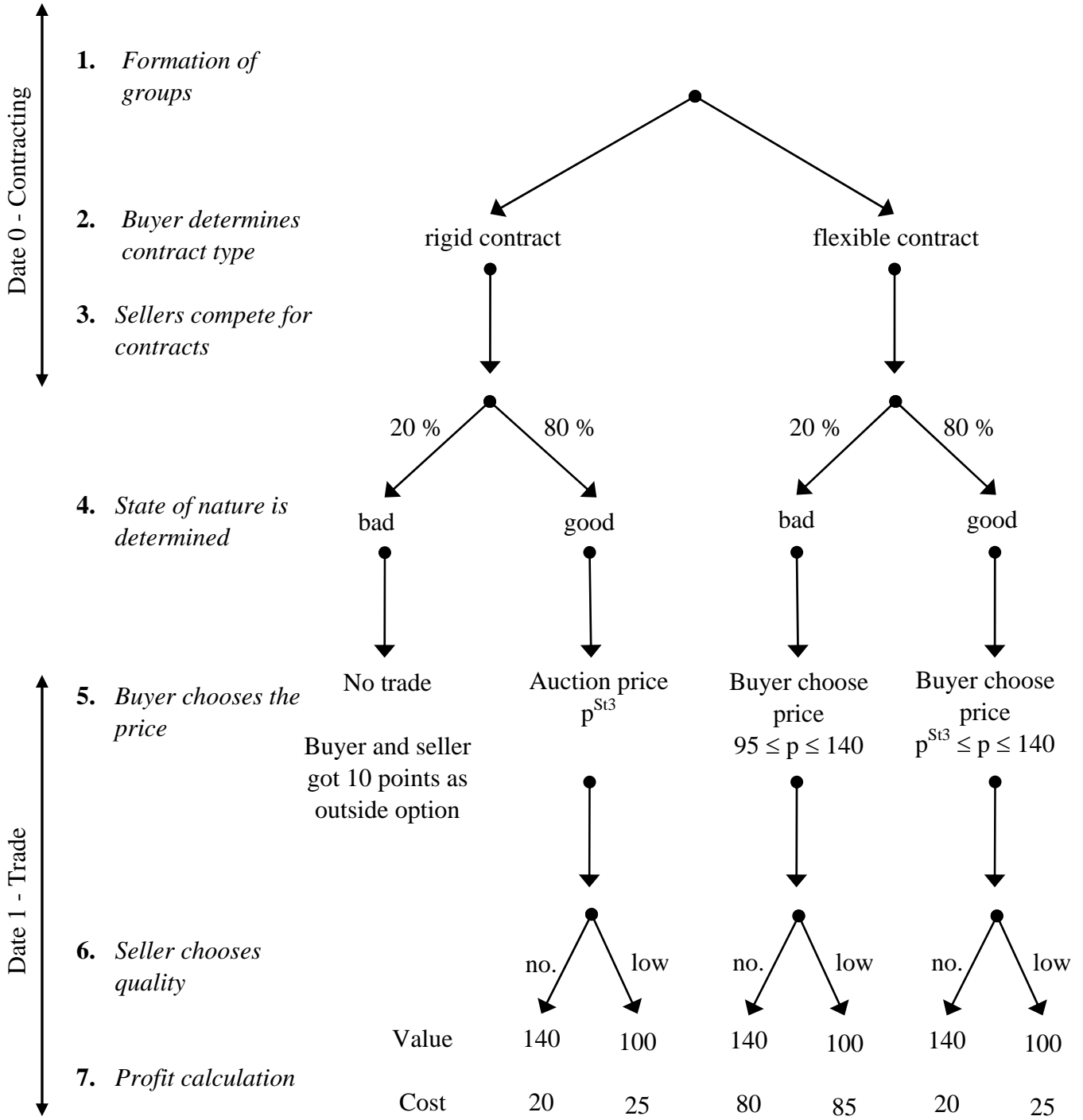
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Appendix

Table 8: Aggregate Results

Treatment Contract Type	Endogenous Contracts		Exogenous Contracts	
	Rigid	Flexible	Rigid	Flexible
Rel. Freq. of Contracts	.277	.723	.48	.52
Auction Price (mean)	38.69	37.41	38.44	37.03
Final Price (mean)	38.69	47.57 / 97.8	38.44	48.38 / 98.87
Rel. Freq. of low quality	.322	.341	.147	.184
Profit Buyer (mean)	65.69	61.2	73.12	70.88
Profit Seller (mean)	15.1	22.44	15.91	24.94

Figure 2: Structure of Each Period



Legend:

- low – low quality
- no. – normal quality
- $p^{St3}$  – auction price