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# Concession Patterns in Multi-issue Negotiations and Reverse Auctions

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**Abstract**

Concession-making plays an important tactical role in interactions among business partners. In multi-issue negotiations a concession refers to the amount of utility a party decides to give up by making next offer. In multi-attribute auctions concession is reflected in the next bid by a bidding party that abides by the rules of a given auction mechanism. The purpose of this work is to share insights into concession-making behavior in multi-bilateral multi-issue negotiations vs. multi-attribute reverse auctions. To this end experiments have been conducted featuring auction and negotiation mechanisms. One finding indicates that participants in auctions tend to make larger concessions than those involved in negotiations. Another finding shows that the negotiators' effort to make a concession may not be perceived by their counterparts.

Keywords: auctions, negotiations, concession making, multi-attribute auctions, online auctions, e-negotiations, decision support systems, experimental study, e-procurement.





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# 1. Introduction

Concession in negotiation implies that one party agrees on a worsening of their position (represented by an offer) with the purpose of convincing the other party to reciprocate. It is "a change of offer in the supposed direction of the other party's interests that reduces the level of benefit sought" (Pruitt 1981, p. 19). Negotiators make concessions in order to move towards an agreement, prevent the counterpart from leaving the negotiation, and encourage the counterpart to reciprocate (Komorita and Esser 1975; Bateman 1980).

Negotiation is not about making concessions, but in many situations concessions play a key role in reaching an agreement. The situations in which the participants realize—through information exchange and learning—that a solution exists which benefits them all and which does not require anyone to yield or compromise on any issue are infrequent. In many other situations, the participants cannot achieve all they aspire to and therefore they need to give in on some issues so that on other issues they get what satisfies them.

There is certain ambiguity regarding the contribution of concession-making on the probability of reaching an agreements and the agreement's value (utility) to each party and to both parties jointly. The theory of gradual reciprocation assumes that concessions should be contingent so that they can be reciprocated (Osgood 1962) can be contrasted with another early theory of a hardening of the concession recipient (Siegel, Fouraker et al. 1961). More recently, Thompson and Hrebec (1996) proposed a strategic concessions model in which one party's first offer is the best possible solution for this party. Being likely rejected by the counterpart, this party then proceeds with next most preferred solution (i.e., makes a minimal concession), then the next one, and so on.

Pruitt (op. cit.), in defining concessions, notes that the direction of change is *supposed*, indicating the subjective and uncertain character of concession making. This is the case when the negotiation concerns multiple issues and the negotiators have different preferences over issues and issue values. If the negotiators have no information about each other's preferences, then concession making may lead to a very bad agreement even in a single-issue negotiation (Follett 1940; Fisher and Ury 1983). Such a possibility is more likely in multi-issue negotiations. One way to alleviate this problem is making concessions on a single issue at a time and asking whether the counterpart prefers the new offer over the previous one. Shakun (2005) proposes such a process coupled with a tit-for-tat (i.e., reciprocal) rule. If, however, the negotiators do not exchange information about their preferences or provide feedback regarding concessions, then concession monotonicity cannot be assured.

Concessions in auctions and multi-bilateral negotiations require taking into account both the counterpart (e.g., the buyer) and other participants who compete with the concession maker in order to reach an agreement. This competition should cause the buyer to be able to extract concessions from the winning seller, which makes it similar to an auction, i.e., the buyer pays the price equal to the second least expensive buyer. This may be the case of a single issue auctions and negotiations, however experiments show that even in this case bidders and negotiators' behavior differ (Thomas and Wilson 2002; Thomas and Wilson 2005).

It is commonly known that negotiation mechanisms can be used for solving multi-issue problems involving two or more decision-makers. The popularity of auctions spurred interests in their application to such problems (Teich, Wallenius et al. 2006; Bellosta, Kornman et al.

2008; Kersten, Pontrandolfo et al. 2012). It is difficult for sellers to make concessions when they are offering non-homogenous products and they do not know the buyer's preferences. The difficulty lies in the sellers' lack of knowledge regarding their competitors' reservation levels, the likely different relationships between issues, and different preferences. This is in addition to the buyer's multiple and unknown preferences.

The purpose of this work is to share insights into concession-making behavior in multi-bilateral multi-issue negotiations vs. multi-attribute reverse auctions. In Section 2 we introduce the concept of concessions and discuss their types and different perspectives on concession-making. Following it, in Section 3, an experiment designed to study concession-making in reverse auctions and in negotiations is introduced. General results of this experiment are also discussed in this section. In the study we focus on sellers who negotiate or bid in order to achieve a contract. In both situations there are several sellers competing for a single contract. Comparison of concessions made by sellers in auctions and negotiations is presented in Section 4. In this section we also compare concessions made in integrative and distributive negotiations. Discussion, presented in Section 5, concludes the paper.

# 2. Concession-making and concession-taking

Popular perception on concessions is that it is a reduction of benefits that the concession-maker seeks to obtain from the concession-taker. We follow this convention and equate concession with "subtraction operator" for the concession-maker and "addition operator" for the concession taker. In other words when concession occurs, a value is subtracted from the benefits of the maker and a value is added to the taker's utility. In price bargaining this process is straightforward: a dollar of concession made by the seller reduces the price increasing saving for the buyer. In multi-issue negotiations, the values reduced and increased represent individual utility, revenue, costs, etc. They are typically different for buyers and for sellers and also within each group.

In order to define and categorize concessions, we use the following notation. Let:

$\boldsymbol{x} = [x_j, j=1, \ldots, n]$ an offer comprising $n$ issues;

$X$ – set of feasible offers, ($\boldsymbol{x} \in X \subset R^n$);

$I$ – set of participating sellers (bidders or negotiators), ($i \in I$);

$u_i$ – value function (utility) of seller $i$; and

$u_b$ – value function (utility) of buyer $b$.

## 2.1 Two perspectives

There are two perspectives on concessions: (1) of the concession maker; and (2) concession taker. We define two perspectives on concession as follows.

Definition 1. Given two consecutive offers $\boldsymbol{x}_t$ and $\boldsymbol{x}_{t+1}$, ($t$ is round index):

1. $u_i(\boldsymbol{x}_t) = u_i(\boldsymbol{x}_{t+1}) - c_{it}$ is seller's $i$, ($i \in I$) perspective on own concession, while
2. $u_b(\boldsymbol{x}_{t+1}) = u_b(\boldsymbol{x}_t) + c_{bit}$ is the buyer's $b$ perspective on concession made by seller $i$.

While both concession parameters $c_{it}$ and $c_{bit}$ refer to the same act, i.e., seller's $i$ proposal to replace offer $\boldsymbol{x}_t$ with $\boldsymbol{x}_{t+1}$, there is an important difference between them. $c_{it}$ reflects the

subjective effort of the concession maker that he makes in order to reach an agreement. Beyond this, however, is has little effect on the process. This is because the progress of the process is determined by the buyer, who is the concession taker.

If $c_{bit}$ is not positive, then the buyer rejects offer associated with this concession because she prefers another offer over the one made by this concession maker. Therefore, the buyer expects that an offer made by a seller is an improvement over the earlier offers made by this and other sellers.

In auction, the offer made in round $t$ is considered in the next round which is the best for concession taker, that is, $c_{bi^*t} \geq c_{bit}$, where $i, i^* \in I, i \neq i^*$.

In general, it is possible that the concession maker makes reverse concession (improves his position for himself) but the concession taker sees the change as a positive concession. The reverse situation is also possible.

## 2.2 Defining positive, negative, and null concessions

Concession carries a message that the concession-taker is willing to move towards the concession-taker; that one side considers interests and needs of the other side. In this sense, we can say that a concession is positive because it reflects an effort to reach an agreement. By the same token, a concession is negative if it appears to push the parties away from an agreement. The third possibility is a null concession, which does not move either towards or away from an agreement.

Concessions made by one side need not to be considered as such by the other side because the perspective the concession-maker wishes to convey may not be visible to the concession-taker. The two perspectives on concessions taken together with concession impact on buyer's and seller's utility values allow us to distinguish nine categories of concession pairs. They are shown in Table 1 for buyer $b$ and seller $s$, ($s \in I$).

**Table 1.** Nine categories of concessions[1]

| Seller | Buyer | | |
|---|---|---|---|
| | Positive | Null | Negative |
| Positive | $c_s > 0; c_b > 0$ | $c_s > 0; c_b = 0$ | $c_s > 0; c_b < 0$ |
| Null | $c_s = 0; c_b > 0$ | $c_s = 0; c_b = 0$ | $c_s = 0; c_b < 0$ |
| Negative | $c_s < 0; c_b > 0$ | $c_s < 0; c_b = 0$ | $c_s < 0; c_b < 0$ |

[1] $c_s = c_{st} = u_s(\boldsymbol{x}_t) - u_s(\boldsymbol{x}_{t+1})$ ; $c_b = c_{bst} = u_b(\boldsymbol{x}_{t+1}) - u_b(\boldsymbol{x}_t)$

Some of the concessions listed in Table 1 have been discussed in negotiation literature. For example, the pair ($c_s < 0; \ c_b > 0$) can be associated with "win-win" because it leads to both concession-maker and concession-taker improving their position. The pair ($c_b > 0; \ c_b < 0$) is a "lose-lose" because both sides are worse off while ($c_b > 0; \ c_b > 0$) is "lose-win" and it corresponds to what a typical concession is assumed to be.

### 2.3 Concession types

In addition to the two perspectives based on the concession maker and taker, we also distinguish the following two types of concessions:

1. Single-issue concession is defined by two consecutive offers (bids) made by the same seller which differ in the value of only one issue. For example, if the concession involves issue $k$, then $c^k_{st} = u_s(x_{1,t}, ..., x_{k,t+1}, ..., x_{n,t}) - u_s(x_{1,t}, ..., x_{k,t}, ..., x_{n,t})$.
2. Multiple-issue concession is defined by two consecutive offers (bids) made by the same seller which differ in the value of two or more issues. For example, if the concession involves issues $k$ and $n$, then $c^k_{st} = u_s(x_{1,t}, ..., x_{k,t+1}, ..., x_{n,t}, x_{n,t+1}) - u_s(x_{1,t}, ..., x_{k,t}, .., x_{n,t})$.

Multiple-issue concessions allow for logrolling, is a decrease of one issue value which is offset by an increase in another issue value. The purpose of logrolling is to improve the offer for the concession taker but at a minimum costs to the concession maker (Pruitt 1983; Kersten and Szapiro 1986).

## 3. Experiment

To study concession making in auction and negotiations we conducted a laboratory experiment.

### 3.1 Settings

The experiment involved students from a Canadian university. The auctions and negotiations were conducted in a lab and, together with the preparation time they lasted two hours. Every buyer was paired with four anonymous sellers. The sellers did not know the other sellers who were also competing for the same contract.

The buyers were senior undergraduate and graduate students who received detailed instructions regarding their behavior. They were in locations different than the sellers. Some of the buyers were asked to follow a cooperative strategy, while others—a competitive strategy (instructions that were given to buyers are available at:
http://invite.concordia.ca/docs/12BuyerComp.pdf,
http://invite.concordia.ca/docs/IntegraBuyer12.pdf).

The sellers were neither trained nor informed about the approach of the buyers. The sellers were first year undergraduate students and they were located in two labs. The assignment of undergraduate students to participate either in an auction or a negotiation and subsequent allocation to the negotiation with a competitive or cooperative buyer was randomized. The percentage of students in different age groups did not vary between these three treatments ($\chi^2(10, N = 268) = 16.04$, $p = 0.098$). The percentage of male and female students did not differ in each of the three treatments ($\chi^2(4, N = 268) = 6.4$, $p = 0.171$). The percentage of students with different education level did not vary between these three treatments ($\chi^2(4, N = 265) = 1.787$, $p = 0.775$).

The participation in auctions or negotiations was a part of the assignment. The assignment grade was based on the report on the process and it did not depend on the results (i.e., the agreement and its rating).

The participants conducted their activities via two systems: Imbins for multi-bilateral negotiations and Imaras for multi-attribute auctions (Kersten, Pontrandolfo et al. 2012). The

systems have similarly looking interface and provide the same data visualization tool and decision and negotiation support aids. The main part of the system related to concession-making is the "Make bid" or "Make offer" page. On this page users can formulate either the offer or bid by selecting the option values from the drop down lists for each issue or by entering the rating value of an offer or a bid they wish to submit. In the second case the system will provide the list of available option values combination that they can use. The main difference between the auction system interface and the one for negotiations is that in auctions the interface shows allowed bids for the current round, while in negotiations users can submit offers at anytime.

## 3.2 Procurement case

Participants in both auction and negotiation experiments were given the same procurement case. The case involved a producer (buyer) who was seeking a transportation and logistics provider. The buyer needed to award a contract in which three clauses were specified and agreed upon. These clauses correspond to the following three attributes: (1) standard rate of transportation (2) rush rate for unexpected delivery; and (3) penalty for delay in providing customers with the requested goods on time. For each attribute, ranges for possible attribute values were given to every participant. The participants were given a rating calculator which allowed them to compare every alternative (bids, offers, and counteroffers). Rating was used to aggregate preferences of individual sellers and buyers and it was based on a profit function.

In each instance four sellers were trying to get a contract. The sellers' preferences differ as well as their breakeven points at which profit turns into losses. The result of these differences was that the sellers had different theoretical chances of getting the contract. In Table 2 the seller's rating corresponding to the breakeven point for each role is shown.

**Table 2.** Sellers' breakeven point and the best corresponding offer rating for the buyers

| Breakeven rating for one seller and corresponding best rating for other sellers | Seller | | | |
|---|---|---|---|---|
| | Cres | Nart | Peka | Rito |
| - Breakeven point for Cres | ***25*** | 62 | 45 | 50 |
| - Breakeven point for Nart | 15 | ***10*** | 20 | 8 |
| - Breakeven point for Peka | 10 | 7 | ***15*** | 4 |
| - Breakeven point for Rito | 51 | 36 | 59 | ***22*** |
| Buyer's rating of the best offer at sellers breakeven point | ***87*** | ***92*** | ***90*** | ***89*** |
| Buyer's rating of the worst offer at sellers breakeven point | 50 | 80 | 90 | 42 |

There may be many alternatives associated with the same rating. Therefore we can select an alternative for which the seller's profit is zero (i.e., corresponding to the breakeven point) but the buyer's rating assumes the highest value, i.e.,

$$\max u_B(\boldsymbol{x}_j) : \boldsymbol{x}_j \in \underline{X}^i, \text{ where } \underline{X}^i \ (\underline{X}^i \subset X), \text{ is set of breakeven points for seller } i,\ i \in I.$$

The highest buyer's rating for each seller is also shown in Table 2.

We may also select an alternative from these yielding breakeven value for a given seller and the highest is highest rated for another seller. There were four sellers in the experiment: Cres, Nart, Peka and Rito (in the case they were known by their full names). The breakeven rating

for Cres is 25; the best alternative for the buyer, which for Cres has rating 25, has rating 87. The best alternative for Nart, from among breakeven alternatives for Cres, yields rating 62. Ratings for other sellers are given in Table 2.

We see that there are two theoretical winners and the seller who wins the contract depends on this seller's strategy. If seller Nart offers an alternative that yields 10 for her and 92 for the buyer, then she wins. If however, seller Peka pre-empts *N* and offers an alternative that yields 15 for him, then Nart cannot make a better offer because the best offer for him yields negative profit of 3 (7 – 10). In this case, the buyer gets less than he could if Cres wins (90 rather than 92).

## 3.3 General results

A total of sixty-three negotiation instances were carried out; in each negotiation one buyer negotiated with four sellers. In addition to the negotiation experiments, eleven multiattribute reverse auction experiments were also carried out. In both experiments, the participants used systems which provided them with decision support aids, including, calculator which could rate every alternative by assigning a score between zero and one hundred, generate alternatives for a given rating value, and select alternatives using graphical tools (Kersten, Pontrandolfo et al. 2012; Kersten, Pontrandolfo et al. 2012). Selected information about the results is given in Table 3.

**Table 3.** Sellers' auction and negotiation results

| | Auction | Negotiation | |
|---|---|---|---|
| | | Integrative | Competitive |
| No. of instances | 11 | 31 | 32 |
| Time (hrs. avg.) | 20 | 35* | 36* |
| *Preparation* | | | |
| Reservation level (avg. rating, sellers) | 32.07 | 33.80 | 38.52 |
| Aspiration level (avg. rating, sellers) | 66.19 | 66.21 | 65.82 |
| *Process* | | | |
| First offer (avg. sellers' rating) | 75.19 | 82.66^ | 75.97+ |
| First offer (avg. buyers rating) | 26.30 | 18.37^ | 27.17+ |
| No. of bids and offers | 4.9 | 6.33^ | 6.51^ |
| No. of buyer's messages (avg.) | n/a | 7.1 | 11.9+ |
| - Message length (characters) | n/a | 214.8 | 144.2+ |
| No. of sellers' messages | n/a | 2.5 | 3.4# |
| - Seller's message length | n/a | 178.7 | 195.7 |
| *Outcomes* | | | |
| Agreement (%) | 100 | 93.5 | 93.8* |
| Agreement (avg. rating, sellers) | 8.6 | 29.5* | 24.5 |
| Avg. seller's profit | -8.6 | 11.5* | 4.8* |
| Avg. buyer's profit | 78.8 | 63.6* | 69.8*# |
| No. of dominating alternatives | 0.1 | 1.7 | 1.0 |
| Overall satisfaction (1-7) | 4.8 | 5.1 | 5.1^ |

Significance compared to auctions: * $p \leq 0.01$; ^ $p \leq 0.05$, and between integrative and competitive negotiations: + $p \leq 0.005$; # $p \leq 0.05$

On average negotiations took longer than auctions (35 and 36 min. vs. 20 min.). This is understandable because the sellers were interacting with the buyers and they needed time to write and read messages.

After reading the case that included information about their roles, the participants were asked to formulate alternatives which corresponded to their worst but still acceptable alternative (rated as a reservation level) and the alternative which they would like to achieve (aspiration level). A difference between bidders and negotiators could take place because the participants knew the mechanisms they were going to use. This difference was not observed with the exception of reservation levels for the cooperative negotiators, which was, however, not significant.

First offer in negotiations is one of the indicators of competitive vs. cooperative approach. Sellers who negotiated with cooperative buyers made significantly ($p$ = 0.03) higher first offers than the sellers who faced competitive buyers. This may be due to the former perception of being able to exploit their counterpart (buyer). Because of anchoring, higher first offers tend to impact the agreements. This may be one reason why sellers in integrative negotiations achieved significantly higher ($p$ = 0.04) profit than those engaged in competitive negotiation. Correspondingly, cooperative buyers achieved lower profit than competitive buyers. Another reason may be that the former wanted to give a "fairer" contract than the latter.

The number of offers is significantly different when auctions are compared to all negotiations and between integrative and competitive negotiations.

In our experimental settings the outcome of every auction is an agreement. This is because the initial auction reservation levels are very favorable for the sellers. This is not the case for the negotiation in which the buyer has to accept an offer. Therefore, the percent of agreements is generally lower in negotiations than in auctions.

Sellers profit in negotiations is significantly higher than in auctions. The difference of mean profit values auctions and negotiations is 16.6 ($p$ < 0.00); it is 20.1 when auctions are compared to integrative negotiations and 13.4 when they are compared to competitive negotiations. This may be one reason for the negotiators' overall satisfaction being significantly higher than the bidders' satisfaction ($p$ = 0.03).

In Table 2 we presented possible winners under the condition that no seller was willing to incur losses. In Table 4 results from the experiments are given. Observe that neither Nart nor Peka, who were the theoretical winners, obtained all contracts. In auctions they won 54.4% of contracts, in integrative negotiations – 51.7% and in competitive negotiations – 40%.

**Table 4**. Distribution of winners according to their role

| | Auctions | Negotiations | |
|---|---|---|---|
| | | Integrative | Competitive |
| Cres | 3 (27.3%) | 8 (27.6%) | 15 (50%) |
| Nart* | 4 (36.4%) | 7 (24.1%) | 6 (20%) |
| Peka* | 2 (18.2%) | 8 (27.6%) | 6 (20%) |
| Rito | 2 (18.2%) | 6 (20.7%) | 3 (10%) |
| Number of agreements | 11 | 29 | 30 |

* Theoretical winner

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We find the results given in Table 4 puzzling and will try to test whether they are particular to this experiment or there some underlying reasons causing them.

# 4. Sellers' concession behaviour

## 4.1 Concessions in auctions and negotiations

The results of the experiment related to the sellers' concession-making are shown in Table 5.

The average total concession in auctions (58.2) is significantly higher than in negotiations (34.0 and 36.2). Mean concession per bid in auction is equal to 14.9, while in negotiations they are equal to 6.4 and 6.6 for cooperative and competitive processes respectively. There are several reasons why auctions appear to be a much better transaction mechanism than negotiations. For example, in negotiations the sellers may ask the buyer to make concessions; also they do not know what other sellers are proposing except for the information conveyed by the buyer. Another possibility is that because buyers are not competing among themselves for a contract, they are in monopolistic situation, while sellers are not. Although in negotiations, buyers are also in a monopolistic situation they are socially present allowing the buyers to raise their concerns, ask for explanations, refer to fairness or compassion, and make some promises.

**Table 5.** Comparison of sellers' behavior in actions versus two types of negotiations

| | Auctions | Negotiations[1] | |
|---|---|---|---|
| | | Integrative | Competitive |
| Total concession (avg. seller's rating) | 58.2 | 34.0* | 36.2* |
| Total concession (avg. buyer's rating) | 62.7 | 37.3* | 36.6* |
| No. of offers/bids (avg.) | 4.9 | 6.3* | 6.5* |
| - Submitted by winners | 5.6 | 6.8 | 7.1 |
| Concession per offer/bid (avg. sellers' rating) | 14.9 | 6.4* | 6.6* |
| Concession per offer/bid (avg. buyers' rating) | 16.1 | 7.0* | 6.7* |
| No. (%) of null concessions[2] | 3 (1.8%) | 50 (8.5%) | 57 (9.0%) |
| No. (%) of negative concessions | 15 (8.9%) | 92 (15.6%) | 106 (16.8%) |

[1] Significance compared to auctions; * $p \leq 0.01$; ^ $p \leq 0.05$

[2] Total number (% of the total)

Another interesting observation coming from this experiment is that there is little difference between competitive and cooperative buyers in terms of the sellers' concessions and, accordingly, their substantive outcomes. The average number of bids in auctions is smaller than the average number of offers in negotiations. This difference is significant for all sellers.

Sellers made greater concessions per bid in the auctions than in the negotiations but they submitted fewer bids on average than the average number of offers made in the negotiations. Because the average profit made by the winner was smaller in the auctions than in the

negotiations (Table 3), the winner had to make greater concessions per bid in an auction than she had to do in a negotiation.

In the auctions null concessions were less frequent than in the negotiations. The reason is that the auction mechanism forces bidders to submit one round of bids with ratings higher for the buyer than in the previous round. While in general this did not assure that the sellers must make concessions when they move from one round to another, it took place frequently.

There is no significant difference in the average number of offers made in integrative and competitive negotiations.

## 4.2 Observed positive, null, and negative concessions

Our proposition (see Section 2.2) to distinguish positive, null and negative coupled with two perspectives led to nine possible configurations shown in Table 1. The number of concessions in each category is shown in Table 6.

The bidders in auctions made positive concession in buyer's rating which corresponded to negative concessions in their ratings in 8.9% of cases. That means that they submitted a new bid with a better rating for themselves and with a better rating for a buyer than their last bid. The sellers in negotiations made positive concession in buyer's ratings which correspond to negative concession in sellers' ratings less frequent (6.9% and 4.5%). The bidders in auctions were well informed about this situation, because auction mechanism only allows them to make positive concessions in buyers' rating. The bidders could also see whether they could improve their rating or not.

**Table 6**. Positive, null, and negative concessions from two perspectives

| | Concession-taker: buyer (buyer' rating) | | |
|---|---|---|---|
| Concession-maker: seller (seller's rating) | Positive | Null | Negative |
| | *Auctions* | | |
| Positive | 150 (89.3%) | n/a | n/a |
| | 3 (1.8%) | n/a | n/a |
| | 15 (8.9%) | n/a | n/a |
| | *Integrative negotiations* | | |
| Positive | 382 (90.7) | 3 (7.9%) | 61 (47.3%) |
| Null | 10 (2.4%) | 31 (81.6%) | 9 (7%) |
| Negative | 29 (6.9%) | 4 (10.5%) | 59 (45.7) |
| | *Competitive negotiations* | | |
| Positive | 410 (92.8%) | 4 (10.5%) | 54 (35.8%) |
| Null | 12 (2.71%) | 33 (86.7%) | 12 (7.9 %) |
| Negative | 20 (4.5%) | 1 (2.6%) | 85 (56.3%) |

The auction mechanism forces bidders to either submit bids that yield positive concessions for the buyers or not to submit bids at all. Therefore, no bids are shown for auctions in Table 5– columns Null and Negative. Table 5 also shows that this is not the case for negotiations; there

were many offers that yielded null or negative concessions for the buyer. Buyers may see such offers as a set-back because they are worse for them than an earlier offer, this may introduce confusion or dismay. Therefore buyers, may reply with a win-lose offer, which, in turn, the seller would consider as a set-back. In effect the negotiation would move in a back-and-forth rather than in a monotonic fashion which moves the parties toward an agreement. In contrast, auction process is monotonic.

The sellers in negotiation were not that clearly informed about this situation and they needed to guess what negative concession in their rating corresponded to positive concession in buyers rating. The situation when positive concession for a buyer corresponds to negative concession for a seller happened more often in integrative negotiations than in competitive negotiations. That also could be explained by better understanding of buyer's preferences obtained by sellers when they receive buyer's offers with higher concession in integrative negotiations than in competitive negotiations.

The frequency of null concessions for a buyer that corresponds to negative concession in a seller's rating is higher in integrative negotiations (10.5%) than in competitive negotiations (2.6%). This situation means that sellers were able to improve their rating keeping the same rating for the buyer. That could also be caused by better understanding of the buyer's preferences in integrative negotiations.

In competitive negotiations the sellers gave negative concession in the buyers rating that corresponded to negative concession in seller's rating more often (56.3%) than in integrative negotiations (45.7%). This situation means that the new seller's offer was worse for the buyer and better for the seller than the previous one. If the reason to give a negative concession in buyer's rating was to try to improve his own rating, then this situation should be observed more often when sellers have less knowledge about buyer's preferences. As we mentioned above, sellers may have less knowledge about buyers' preferences in competitive negotiations. If sellers have better knowledge about buyers' preferences in integrative negotiations, they can try to improve their rating without giving a negative concession in buyer's rating. As a result willing to improve a seller's rating was less often a reason to give negative concession in a buyer's rating.

## 4.3 Single- and multi-issue concessions

One of the cognitively difficult activities in auctions and negotiations is making concessions which involve multiple issues. While such concessions allow for logrolling and hence joint improvements when they are possible, they also require assessment of changes caused by two or more issues. The results given in Table 7 show that majority of concessions were multi-issue. One reason for this situation is offer (bid) generator which is included in the systems used by the participants; they could enter a desired rating value and the system would generate seven alternatives.

**Table 7**. Single- and multi-issue concessions

| | Auctions | Negotiations | |
|---|---|---|---|
| | | Integrative | Competitive |
| *Single issue concession* | | | |
| - Number of concessions | 57 (33.9%) | 197 (33.5%) | 204 (32.3%) |
| - Average concession | 10.2 | 5.0 | 5.6 |
| *Multiple issue concessions* | | | |
| - Number of concessions | 111 (66.1%) | 360 (61.2%) | 394 (62.4%) |
| - Average concession | 17.3 | 7.7 | 7.7 |

Multi-issue concessions were higher than the single-issues ones; for auctions the difference is about 70%. For negotiations the difference is much smaller. This suggests that the bidders may

**Table 8**. Logrolling with multi-issue concession

| | Auctions | Negotiations | |
|---|---|---|---|
| | | Integrative | Competitive |
| *Logrolling* | | | |
| - Number of concessions[1] | 61 (55%) | 245 (68.1%) | 248 (62.9%) |
| -Number of concessions positive for concession-taker [2] | 61 (100%) | 145 (59.2%) | 139 (56%) |
| - Average concession in concession-maker rating | 7.0 | 3.0 | 4.3 |
| - Average concession in concession-taker rating | 11.1 | 3.0 | 3.3 |
| *No logrolling* | | | |
| - Number of concessions[1] | 50 (45%) | 115 (31.9%) | 146 (37.1%) |
| -Number of concessions positive for concession-taker[3] | 50 (100%) | 107 (93%) | 122 (83.6%) |
| - Average concession in concession-maker rating[4] | 29.8* | 17.5* | 13.4* |
| - Average concession in concession-taker rating | 31.4* | 19.7* | 15.1* |

[1] % out of all multi-issue concessions, [2] % out of all multi-issue concession with logrolling, [3] % out of all multi-issue concession with no logrolling, [4] Significance compared to the case with logrolling; * $p \leq 0.01$; ^ $p \leq 0.05$

Table 8 shows that in auctions logrolling was observed less often than in negotiations among multi-issue concessions (55% vs. 68.1% and 62.9%). That might be due to the mechanism because the auction system forces bidders to make concessions and the bids that will allow logrolling may not be available for the bidder. Logrolling was observed more often in integrative negotiations than in competitive. That could be caused by better understanding of buyer's preferences.

In negotiations multi-issue concession made with logrolling were positive for a concession-taker in 59.2% and 56%, while multi-issue concessions with no logrolling were positive for concession-takers in 93% and 83%. That is not surprising because it is more likely for a seller to submit a better offer for a buyer when he is not trying to improve values on any issue for

himself.

As we stated above the purpose of logrolling is to improve the offer for a concession-taker with a minimal cost for concession-maker. The average multi-issue concession in concession-maker rating made with logrolling is lower than one made without it for all settings. That means that the purpose of logrolling, which is minimization of concession value, was archived. While the percentage of concession that will give an improvement of the offer for a buyer is smaller when sellers apply logrolling than when they don't.

In auctions bidders knew that any of their bids will be better for the buyer and they can use logrolling to minimize their costs. In negotiations logrolling gives about 60% of positive concessions for a concession-taker.

## 4.4 Time and concession-making

In order to find out how the bidder's concession changed as a function of time, we divided the bidders into three groups: short (those who made two bids); medium (those who made more than three and up to seven bids); and long (those who made more than seven and up to nine bids). The changes of the seller's average rating for these three groups are shown on the Figure 1.

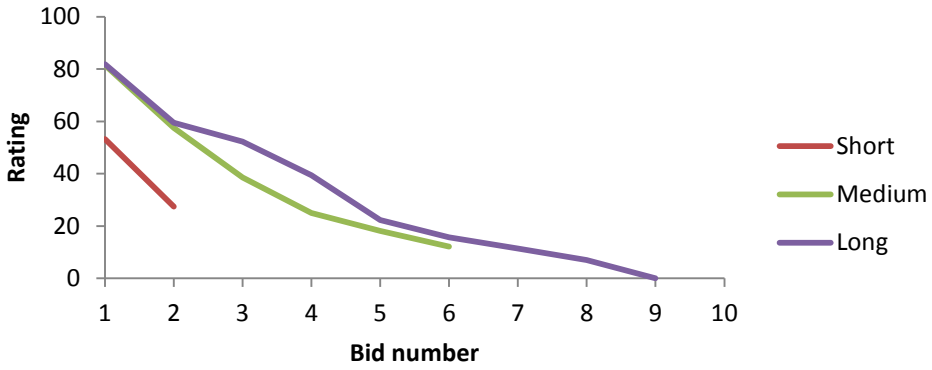


Figure 1. Changes in seller rating values for short, medium and long auctions

We can see that the smaller the number of bids a bidder made the higher the rating value of his last bid. Another interesting observation is that the shape of the graph for medium and long auctions is hyperbolic. This means that the concession value decreases with the increase of the bid number in medium and long auctions.

Figure 1 shows that long auctions have a bump on the ratings chart after the second offer. This means that the average concession made with the third offer in long auctions was lower than the one in medium auctions. The question for future analysis is whether or not this effect resulted in a longer auction duration.

We divided the sellers in negotiations into four groups: short (those who made two or three offers); medium (those who made more than three and up to six offers); long (those who made more than six and up to nine offers); and very long (those who made more than nine and up to twelve offers). The changes in the sellers rating values are shown on the Figure 2.

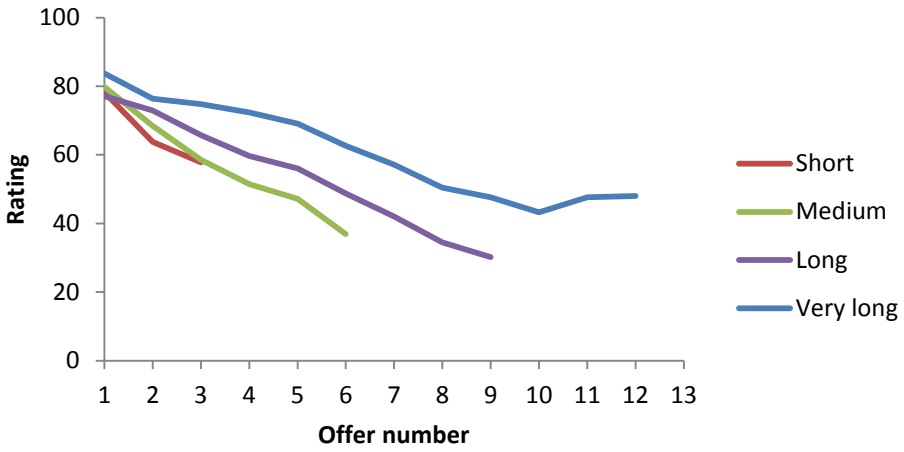


Figure 2. Changes in seller rating values for short, medium, long and very long negotiations

We can see that, as opposed to auctions, the shape of the rating values graphs is closer to be linear, with the exception of the end part for very long negotiations. That means that concession value did not change with the increase of the offer number. The angles of the lines in Figure 2 show that the average concessions value is smaller in longer negotiations. There was a significant effect of the number of offers submitted by a seller in negotiations on the average concession value for four classes [$F(3,956)=8.822$, $p=0.000$]. In groups corresponding to a shorter negotiations average concession values were higher.

## 4.5 Buyers' activities and concession making

We mentioned (Section 1) that one concession-making theory relies on reciprocity. This suggests that one the first concession is made subsequent concessions are made in response to an earlier concession. To test this assumption we divided concessions made: (1) after an offer was received; (2) right after an offer was received; and (3) when the seller received neither an offer nor a message prior to his last offer. The results are shown in Table 9.

**Table 9.** Concession making depending on buyers' activities

| | Nothing received | Received message(s) only | Received at least one offer |
|---|---|---|---|
| | *Integrative negotiations* | | |
| Concession in sellers' rating | 5.2 | 6.7 | 7.8$^{\wedge}$ |
| Concession in buyer' rating | 5.3 | 8.0 | 8.6$^{\wedge}$ |
| | *Competitive negotiations* | | |
| Concession in sellers' rating | 3.2 | 7.5$^{\wedge}$ | 8.9$^{*}$ |
| Concession in buyer' rating | 3.4 | 7.6$^{\wedge}$ | 8.9$^{*}$ |

Significance compared to the case when nothing was received; $^{*}$ $p \leq 0.01$; $^{\wedge}$ $p \leq 0.05$

We found no significant difference between the case when messages were received and the case when offers were received. There is no significant difference between the average concession values made in the same situations in different treatments.

## 5. Discussion

The purpose of this study was to examine concession making behavior of sellers in multi-bilateral negotiations with a single buyer in reverse auctions. One of the major findings is that in auctions sellers make bigger concessions, and, subsequently the winners end up with relatively unfavorable agreements as compared to negotiations. Therefore, the slope of the curve describing concession-making behavior through time is steeper. This result is most likely due to the fact that auction mechanism imposes more constraints on the permissible bids and thus restricts the space of feasible offers for the sellers. In multi-bilateral negotiations, however, there is more space for the search of joint solutions, and there is also a possibility of using concessions as means of eliciting reciprocal steps from the buyers. Thus, the average concessions by the seller are smaller, and the outcomes are relatively more favorable.

It is interesting to note, that there was not a significant difference between average concessions by the sellers when comparing competitive vs. cooperative buyers. This might be due to the fact that in multi-bilateral settings sellers do not only compete with the buyers, but also, in effect, with each other. Another interesting finding is that in negotiations there was a relatively large portion of concessions made by the sellers, which had actually negative effect on the buyers' ratings. In auctions, on the other hand, this portion was much lower. Thus, while negotiations may allow for the exploration of negotiation space, including making concessions that are unfavorable to the opponent, auctions, through an appropriate mechanism design limits the number of such incidents.

Another interesting result is that win-win bids were observed more often in auctions than win-win offers in negotiations. Lose-lose bids were not allowed in auctions, whereas lose-lose offers were observed in negotiations. This suggests that a small change of the negotiation mechanisms could increase its effectiveness; this change would allow both the sellers and buyers to know that they make offers that are worse for their counterparts. In order to make such a modification we need to design an intermediary that informs the participants when they want to submit an offer and whether this offer can be accepted by their counterparts. This requires that the intermediary know the rating functions of all participants. In an auction, the information is given by the bid-taker, that is, the buyer. In a negotiation, both sides need to convey this information. An alternative mechanism modification is to provide every negotiator with a verification component. This component does not pass an offer to the negotiator if this offer does not yield a positive concession for this negotiator.

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