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Concession-making in Multi-bilateral Negotiations and Multi-attribute Auctions

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Abstract

Reverse auctions and negotiations are two common procurement mechanisms. The drawback of many auctions is their sole focus on price. The drawback of negotiations is that they are sequential, slow and costly. Internet enables multi-attribute auctions and multi-bilateral multi-attribute negotiations efficiently. In both processes concession-making plays a key role. The paper presents typology of concessions, which has been empirically verified. The results show that: (1) bidders and negotiators use all types of permissible concessions; (2) bidders make more concessions in auctions than in negotiations; and (3) use of single- and multiple- attribute concessions differs between auctions and negotiations. The results also show that buyers obtain the highest profit through auctions, then competitive negotiations and the lowest through cooperative negotiations. The reverse is true for the sellers.

Keywords: reverse auctions, multi-attribute auctions, multi-bilateral negotiations, concession-making, behavioral experiments

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1. Introduction

In social interactions people need to hear, accommodate and even accept arguments made by others. This means that often they need to make concessions. The popular meaning of concession is giving away something to a person who asked for it, or yielding. Concession-making in negotiations has been extensively studied experimentally and in the field (Cialdini, Vincent et al. 1975; Esser and Komorita 1975; Kwon and Weingart 2004). Research shows that negotiators make concessions in order to move towards an agreement, to prevent the counterpart from leaving the negotiation, and to encourage the counterpart to reciprocate (Komorita and Esser 1975; Bateman 1980).

There is more to negotiation than concession-making. Concessions are focused on the substantive issues and discount education and learning. And it is learning that may be the key to successful negotiations (Zartman 1977; Spector 2007). Such widely accepted concepts as "win-win negotiation" may rely on the negotiators' realization that they may not be in opposition and that there may be alternatives that satisfy everybody's needs (Fisher and Ury 1983; Schneider 2002; Raiffa, Richardson et al. 2003). Admittedly though, in commercial and business exchanges, concessions play a key role in reaching an agreement.

1.1 Concession-making

Concession-making may appear to be a simple process. According to Pruitt (1981) it is a change of the negotiator's position that reduces the level of benefit sought and is seen as an improvement by the counterpart. Concessions, we are told, are advantageous because of their potential: if both parties make concessions, then they should reach an agreement. However, the relationship between concessions and agreement is, as we show in this paper, not as straightforward as it appears.

Even if we assume that concession is the key ingredient of reaching an agreement, we need to determine when and what concessions should be made in order to achieve an agreement that is beneficial to the concession-maker and/or to both parties. There is certain ambiguity regarding: (1) concessions' contribution to the probability of reaching an agreement; and (2) 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). This theory may be contrasted with another early theory of a hardening of the concession-taker position (Siegel, Fouraker et al. 1961). Thompson (Thompson 1996) proposed a strategic concessions model in which one party's first offer is the best possible solution for this party. The probability that it will be rejected by the counterpart is high. When this happens, then the party proceeds with the next most preferred solution (i.e., makes a minimal concession), then the next one, and so on.

Concession-making becomes more complex when a negotiation concerns multiple attributes and the negotiators have different preferences over attributes and their 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-attribute negotiation (Follett 1940; Fisher and Ury 1983). Such a possibility is more likely in multi-attribute negotiations. One way to alleviate this problem is to make concessions on one attribute at a time and to ask whether the counterpart prefers the new offer over the previous one. This process can be coupled with a tit-for-tat (i.e., reciprocal) rule (Shakun 2005). If, however, the negotiators do not exchange information about their preferences or do not provide concrete feedback regarding concessions, then concession monotonicity cannot be assured.

Based on the assumed contribution of concessions to agreements a number of algorithms have

been formulated with the purpose to support human negotiators (Chen, Vahidov et al. 2005; Kersten 2005) and to construct negotiation software agents (Meyer, Foo et al. 2004; Lopes and Coelho 2010; Yang, See et al. 2010). To account for the lack of information that the concession-maker has about the preferences and interests of the concession-taker several methods have been proposed, including, the structural (dis)similarity of alternatives (Faratin, Sierra et al. 1998) and the monotonicity and strength of the parties opposition to the preferences over the negotiated attributes (Kersten and Noronha 1998; Endriss 2006). These and other works rely on the typical, albeit inaccurate, conception of concession, namely that making "lose-win" concession, in which the concession-maker accepts a loss for the benefit of the concession-taker to improve their position, is necessary to reach an agreement.

1.2 Multi-bilateral negotiations

Face-to-face business negotiations are presumed to be bilateral (Bonaccorsi, Lyon et al. 2000; Bajari, McMillan et al. 2009; Subramanian 2010). Multi-bilateral face-to-face negotiations may be preferred over bilateral, however they have high costs, are cumbersome in terms of gathering all participants in the same place, and are prone information leakage and collusion when multiple bid-takers are located in close proximity. Therefore, they are considered difficult and often impractical. Despite the high costs and other difficulties there have been instances of gatherings of several potential buyers (sellers) in multi-bilateral face-to-face negotiations, for example, the sale of the Universal by Vivendi and Glenmorangie whisky distiller to LVMH (Subramanian and Zeckhauser 2004).

The concept of multi-bilateral negotiation is not new; such negotiations have been practiced among governments and large business organizations (Dahrendorf 1973; Shakun 2005). In the past, conducting such negotiations was an effortful, slow and costly process. Similarly to auctions all parties had to gather in one place. In addition, the single-part side (e.g., buyer in procurement negotiation) had to either accept transparency and negotiate with one counterpart in the presence of the other counterparts or shuttle from one counterpart to another. Online marketplaces removed the costs and other frictions associated with participation, making multi-bilateral negotiation a viable option. Multi-bilateral negotiations and auctions are used in similar settings, even by apparently similar participants, in narrowly defined markets (Thomas and Wilson 2012).

1.3 Reverse auctions

In addition to studying concession-making in multi-bilateral negotiations, the paper also presents concessions made by bidders in multi-attribute reverse auctions. These two mechanisms are selected because: (1) they are the key mechanisms in procurement; and (2) they are comparable – both deal with multiple sellers and a single buyer. The multi-attribute problem is selected because this type of problems is typical for procurement (Ferrin and Plank 2002).

Auction literature is concerned with the design of mechanisms followed by studies of their allocative efficiency, revenue maximization, fairness and other features of the mechanism (Bichler 2000; Bichler and Kalagnanam 2005). With the exception of the consideration of concession-making by software agents that participate in auctions (Faratin, Sierra et al. 1998; Sim and Wong 2001), little has been said in auction literature about concessions made by human participants.

Auctions are defined by an explicit set of rules which determine resource allocation and prices on the basis of the offers made by market participants (McAfee and McMillan 1987). The following four characteristics differentiate auctions from other exchange mechanisms (Kersten, Chen et al. 2008):

1. Auction rules are *explicit* and known to the bidder, prior to the auction. Therefore, rules cannot be modified during the auction.

2. The rules describe the mechanisms completely thus allowing for the determination of one or more winners solely based on the offers. Auctioneers or any other parties have no discretion in the winner choice.
3. Rules typically include:
    a. *bidding rules* stating how offers can be formulated and when they can be submitted;
    b. *allocation rules* describing who gets what on the basis of submitted offers; and
    c. *pricing rules* selecting the auction winner and stating the prices, which the bidders have to pay.

In multi-attribute auctions the pricing rule is replaced by a scoring or utility rule (Che 1993; Branco 1997; Kersten, Wu et al. 2010). Price may but does not have to be included in this rule.

1.4 Overview

This paper builds on and extends an earlier work on concession-making process in auctions and negotiations (Kersten, Gimon et al. 2012). Concession-making process are studied based on two forms of categorization. As far as we know this is the first such specification that has been formulated and experimentally verified.

The purpose of this work is to share insights into concession-making behavior in auctions and negotiations. The next section formalizes the concept of concession and discusses their categories and types. In Section 3, two experiments designed to study concession-making in reverse auctions and in negotiations are introduced. General results of this experiment are also discussed in this section. In the study we focus on the sellers who bid or negotiate in order to obtain 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. Discussion, presented in Section 5, concludes the paper.

2. Concession Categories and Types

2.1 Preliminaries

For the purpose of this study concession is equated with the "subtraction operator" for the concession-maker and the "addition operator" for the concession-taker (Kersten, Gimon et al. 2012). This means that when a concession takes place, then some 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 savings for the buyer. In multi-attribute negotiations, the values reduced and increased represent individual utility, revenue, costs, etc. They are typically different for buyers than 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 attribute;

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

I – set of participating sellers (bidders or negotiators);

t – round index ($t = 1, \ldots, T$);

u_i – value function (utility) of seller I, ($i \in I$); and

u_b – value function (utility) of buyer b.

2.2 Concession bookkeeping

In concession bookkeeping we need to know who provides a concession and to whom. This gives us two different ways of calculating concessions:

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

$u_i(\boldsymbol{x}_{t+1}) = u_i(\boldsymbol{x}_t) - c_{it}$ is seller's i, ($i \in I$) perspective on own concession, while

$u_b(\boldsymbol{x}_{t+1}) = u_b(\boldsymbol{x}_t) + c_{bit}$ 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 the offer associated with this concession because she prefers another offer over the one made by this particular concession-maker. Therefore, the buyer expects an offer made by a seller to be an improvement over the earlier offers made by this and other sellers.

In general, it is possible for the concession-maker to make a reverse concession (to improve his position) but the concession-taker sees the change as a positive concession. The reverse situation is also possible.

2.3 Nine categories

Concessions made by one side need not to be considered as concessions by the other side. This is 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 the concessions' impact on the buyer's and the seller's utility values allow us to distinguish nine categories of concession pairs. Let the seller and the buyer concessions be defined respectively by:

$c_s = c_{st} = u_s(\mathbf{x}_t) - u_s(\mathbf{x}_{t+1})$ and $\quad c_b = c_{bst} = u_b(\boldsymbol{x}_{t+1}) - u_b(\boldsymbol{x}_t)$.

Given this formulae the nine categories are formulated as shown in Table 1.

Table 1. Nine categories of concessions

Concession-maker	**Concession-taker**		
	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	$c_s < 0;\ c_b > 0$	$c_s < 0;\ c_b = 0$	$c_s < 0;\ c_b < 0$

Note that for the concession-makers, a positive concession decreases their utility while positive concession for concession-takers increases their utility.

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 the concession-maker's and the concession-taker's improvement in their position. The pair ($c_s > 0;\ c_b < 0$) is a "lose-lose" because both sides are worse off while ($c_s > 0;\ c_b > 0$) is a "lose-win" and it

corresponds to what a typical concession is assumed to be.

2.4 Two types

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

Single-attribute concession is defined by two consecutive offers made by the same seller, which differs in the value of only one attribute. For example, if the concession involves attribute k, then

$$c^k_{it} = u_i(x_{1,t}, \ldots, x_{k,t+1}, \ldots, x_{n,t}) - u_i(x_{1,t}, \ldots, x_{k,t}, \ldots, x_{n,t}).$$

Multi-attribute concession is defined by two consecutive offers made by the same seller, which differs in the value of two or more attributes. For example, if the concession involves attributes k and n, then

$$c^k_{it} = u_i(x_{1,t}, \ldots, x_{k,t+1}, \ldots, x_{n,t}, x_{n,t+1}) - u_i(x_{1,t}, \ldots, x_{k,t}, \ldots, x_{n,t}).$$

Multi-attribute concessions allow for *logrolling* which is "the exchange of loss on some attributes, usually less important in priority or value, for gain in other attributes, usually more important." (Tajima and Fraser 2001, p. 218). The purpose of logrolling is to improve the offer for the concession-taker but at a minimum cost to the concession-maker (Pruitt 1983; Kersten and Szapiro 1986).

Single-attribute concessions are often associated with the *sequential negotiation* in which the parties negotiate and agree on one attribute then move to negotiating on another attribute, etc. In contrast, the *simultaneous negotiation* requires that the parties negotiate on all attributes at the same time. Experimental and field studies show that simultaneous negotiations produce better agreements in terms of joint value and lower concessions than those produced in sequential negotiations (Froman Jr and Cohen 1970; Pruitt 1981; Weingart, Bennett et al. 1993).

3. Experiment

In the spring of 2012 we conducted auction and negotiation experiments that allowed us to observe concession-making. The systems, the case and the experimental setting are described in detail in (Kersten, Gimon et al. 2012; Kersten, Pontrandolfo et al. 2012). In this section concession-making of the experiment participants is discussed in detail.

3.1 General results

In the experiment a total of 54 negotiations and 33 auctions were conducted online. In both negotiations and auctions, the participants used systems which provided them with decision support aids, including, a calculator which could: (1) rate every alternative by assigning a score between zero and one hundred; (2) generate alternatives for a given profit value; and (3) select alternatives using graphical tools (Kersten, Pontrandolfo et al. 2012; Kersten, Pontrandolfo et al. 2012).

In each negotiation there were three or four sellers; in each auction there were four sellers. In some negotiation instances the role of one of the sellers was played by a software agent. Software agents had either a competitive or a cooperative strategy. Sellers in the negotiation competed for an agreement awarded from either a cooperative or competitive buyer. The buyers were trained to play these roles.

Since in auctions buyers neither communicate with sellers nor make concessions (the buyers are auction owners), we focus on concessions made by the sellers.

The experiment settings and the number of instances are given in Table 2.

Table 2. Experiment design

			Three sellers	Four sellers
Auctions				31
Negotiations	Integrative buyer	- No agent	11	
		- Competitive agent	6	5
	Competitive buyer	- No agent	4	5
		- Integrative agent	8	2
		- Competitive agent	6	7

Six instances in the negotiations ended without agreement, so we excluded them from the analysis. We removed another six instances in the negotiations where the agents won because we are interested in concession-making by human participants. We ran Kolmogorov-Smirnov non-parametric tests to check if the number of sellers affected the negotiation outcomes and process: it did not. For example, when a competitive buyer negotiated with two human sellers and an agent, the distribution of the sellers' profit was not significantly different from the case with three human sellers and an agent ($p = 0.329$). Since there was no difference between negotiations with three and four sellers, we merged them.

Then, we checked if using an agent or agent strategy affected the outcomes and/or the process. Since there was no significant difference between negotiations with or without agents, or between those with cooperative or competitive agents, we merged those negotiations together. For example, the distribution of the sellers' profit negotiating with a cooperative buyer did not significantly differ when one of the sellers was an agent ($p = 0.998$).

We also removed two auctions which ended with a profit equal to 51 and 63. All the remaining auctions have resulted in an average profit equal to -5.4 and no other auction had a profit greater than 24.

Those results of the experiments which are useful for concession analysis are given in Table 3.

Table 3. General results

	Auction	Negotiation	
		Cooperative	Competitive
No. of instances	31	22	22
% of agreements	100	95	95
Avg. seller's profit	-5.4	17.3*	11.2*#
Avg. buyer's profit	77.4	56.3*	62.1*
% of dominating alternatives	1.6	1.3	0.8

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

Sellers' profit in both cooperative negotiations (17.3) and competitive negotiations (11.2) is significantly higher than in auctions (-5.4). In cooperative negotiations sellers achieve significantly

higher profit than in competitive negotiations (p=0.017). Buyers realize the highest profit in auctions, then the second highest in competitive negotiations and the lowest—in cooperative negotiations.

These results indicate that auctions are more competitive than both cooperative and competitive negotiations. The percentage of dominating alternatives was not significantly different in the two mechanisms.

3.2 Theoretical winners

In our experiments the parties cannot redefine the problem or introduce new and remove current attributes. Therefore, it is only through concession-making that they can "win", i.e., achieve an agreement and become the auction winner. If the participants were rational and completely followed information they were given in the case, then one particular person (role) should win.

Table 4. Breakeven point and corresponding best profit for others

	Seller			
Breakeven points	Cres	Nart	Peeka	Rito
- for Cres	**25**	64	45	53
- for Nart	25	**10**	22	24
- for Peeka	33	30	**15**	32
- for Rito	55	35	62	**22**
Buyer's rating of the best offer at seller breakeven point	**92**	**92**	90	**92**
Buyer's rating of the worst offer at sellers breakeven point	47	80	75	44

In each instance four sellers were trying to get a contract. The sellers' preferences and their breakeven points, at which profits turn into losses, differ. The result of these differences was that the sellers had different theoretical chances to get the contract. Table 4 shows the seller's rating corresponding to the breakeven point for each role.

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.:

$$\max u_B(\boldsymbol{x}) : \boldsymbol{x} \in X^i, (i \in I),$$

where X^i ($X^i \subset X$), is a set of breakeven offers for seller i.

The highest buyer's rating for every seller is also shown in Table 4.

We may also select an alternative from these yielding breakeven values for a given seller and the highest is the highest rated for another seller. There were four sellers in the experiment: Cres, Nart, Peeka 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 92. The best alternative for Nart, from among breakeven alternatives for Cres, yields rating 64. Ratings for other sellers are given in Table 4.

We see that Cres, Nart and Rito are the theoretical winners for both auctions and negotiations. This is because they may offer an alternative that is at their reservation level and which yields rating 92 for the buyer, which is higher than what Peeka could offer without violating his breakeven values.

The auction procedure used in the experiments may bring about another theoretical winner. This

will happen if one bidder can make an offer that is on his reservation level. If this offer yields a rating below another bidder's reservation level, then following this offer, the procedure may remove the alternatives which are above the other bidder's reservation level even if they are better for the buyer. This need not happen in negotiations because the buyer is able to control the removal of alternatives making them infeasible in further offers. Table 3 shows that this is not the case for the preference structures used in the experiment.

3.3 Auction and negotiation winners

Table 4 lists theoretical winners: Cres, Nart, and Rito under the condition that no seller is willing to incur losses. Table 5 gives results from the two experiments.

Table 5. Distribution of winners

	Auctions	Negotiations	
		Cooperative	Competitive
Cres (%)	4 (13)	0 (0)	1 (5)
Nart (%)	15 (5)	8 (38)	5 (24)
Peeka (%)	7 (23)	11 (52)	7 (33)
Rito (%)	5 (16)	2 (10)	8 (38)
Theoretical winners			
Winners (%)	24 (24)	10 (25)	14 (32)
Who did not win (%)	75 (76)	29 (75)	29 (67)
Avg. seller's profit	-4.4	15.7	12.4
Theoretical non-winners			
Winners (%)	7 (28)	11 (58)	7 (41)
Who did not win (%)	18 (72)	8 (42)	10 (58)
Avg. seller's profit	-8.7	18.9	8.9

Table 5 shows the distribution of actual winners among theoretical winners and among other sellers in each of the experiment settings. In auctions the distribution of actual winners (24% among theoretical winners and 28% among others, did not differ ($\chi^2(1, N = 124) = 0.150$, $p = 0.698$). That means that they have equal chances to win. The concept of theoretical winners is based on the assumption that bidders cannot bid below their breakeven points. Since the average sellers profit was negative, bidders bid below their breakeven point. That could explain an insignificant difference in the distributions of winners between the theoretical winners and the others.

In cooperative negotiations 25% of the theoretical winners won, which was significantly rarer than the percentage for other sellers (58%) ($\chi^2(1, N = 58) = 5.754$, $p = 0.016$). In competitive negotiations theoretical winners won in 32%—this did not significantly differ from the percentage of winners among other sellers (41%) ($\chi^2(1, N = 60) = 0.398$, $p = 0.528$). Even this result for cooperative negotiations is puzzling; the fact that theoretical winners did not have significantly higher chances to win than other sellers in negotiations is true for both negotiation settings.

Theoretical winners have an advantage only if other sellers submit offers at the level of their breakeven points. Theoretical winners are able to continue making concession without incurring losses. The results given in Table 5 indicate one or more of the three situations that took place:

1. Theoretical winners were unwilling to make large concession moving them towards their break-even point;

2. Sellers, other than theoretical winners accepted an offer made by the buyer which yielded a small profit for them; and
3. The buyers accepted an offer even though they could have tried to get bigger concessions from the sellers.

The last two situations are in line with social exchange theory which posits that people reciprocate when they are offered something [Bottom, 2006 #1190; Cropanzano, 2005 #754]. In negotiations, contrary to auctions, a relationship is formed, which gives grounds for *reciprocity*—a repayment in kind which does not need to be explicitly formulated by either side of the exchange [Esser, 1975 #778]. Reciprocity rules do not require a long-lasting and/or future-oriented relationship. Building on fairness and social membership pushes people to respond in-kind to concessions they are offered.

4. Concession-making

Participants of auctions and negotiations engage in concession-making in order to achieve an agreement (contract). In auctions every seller is *pushed* by the seller who submitted the most recent winning offer; every seller has to make a concession that increases the value for the buyer more than the current winning concession does. Sellers in auctions make concessions in order to increase the distance between their offer and the most recent offer made by the winning seller. Sellers face very different pressures in negotiations; rather than being pushed they are *pulled* by the offer made by the buyer. Sellers in negotiations make concessions in order to reduce the distance between their earlier offer and the buyer's most recent offer. In this section we analyze and compare concession-making in both auctions and negotiations.

4.1 Concessions in auctions and negotiations

The results of the experiments related to the sellers' concession-making are shown in Table 6.

Table 6. Sellers' behavior

	Auctions	Negotiations[1]	
		Cooperative	Competitive
Total concession (seller rating)	43.8	32.7*	36.5
Total concession (buyer rating)	45.1	36.3^	36.8
No. of offers (avg.)	8.1	3.9*	3.7*
- Submitted by winners	11.7	3.8*	4.7*
Concession per offer (sellers)	6.4	10.1*	11.6*
Concession per offer (buyer)	6.6	11.2*	11.7*
No. (%) of null concessions [2]	41 (5)	3 (2)	3 (2)
No. (%) of negative concessions	138 (18)	9 (6)	8 (5)

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

[2] Per cent of the total no. of all concession.

The average total concession in auctions (43.8) is significantly higher than in cooperative negotiations (32.7, p = 0.001). It is not significantly higher in competitive negotiations (36.5).

There may be several reasons why—from the singular perspective on the buyer's profit—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 the sellers do not know what other sellers are proposing except for the information conveyed by the buyer. Another likely reason is that because buyers are not competing among themselves for a contract, they are in a 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 promises. This important difference is due to reciprocity rules on which people rely in social interactions and which for many may also have a moral dimension (Cropanzano and Mitchell 2005). Therefore, buyers may feel obliged to repay in kind to sellers who make positive concessions.

The average concession per offer in an auction is equal to 6.4, while in negotiation it is equal to 10.1 and 11.6 for cooperative and competitive processes respectively. The difference between auctions and both types of negotiations is significant ($p < 0.001$). The reason for smaller concessions in auctions may be caused by the possibility to send several offers in one round. In such case a small or negative concession may be used to try to find a better offer for the buyer within one round. This strategy is of little cost to bidders.

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

The sellers did not only submit more offers and but they also made greater concessions per offer in negotiations than in auctions. Because the average profit made by the winner was smaller in the auctions than in the negotiations (Table 2), the winner had to make a greater number of offers in an auction than in a negotiation.

Null concessions were more frequent in the auctions than in the negotiations, maybe because in auctions bidders can submit several offers in a round; they may try to find a offer that will be better for a buyer but the same for them. For the same reason the number of negative concessions (meaning that for the seller the new offer was better than the last one) is higher in auctions than in negotiations. Lastly, we found no significant difference in the average number of offers made in cooperative and competitive negotiations.

4.2 Observed concession categories

Our proposition (see Section 2) to distinguish positive, null and negative together with two perspectives led to nine possible configurations shown in Table 1. The number of concessions made by all participants (both winners and non-winners) in each category is shown in Table 7.

Typically, concessions are positive for sellers and buyers. However, the remaining eight categories also occur. This provides empirical evidence for the concession categorization formulated in Section 2.

In the auctions, 29% of concessions were not positive-positive (i.e., lose-win). In 10% they were negative-negative meaning that bidders were able to submit a new offer with a better rating for themselves than their last offer and worse for the buyer. This type of concessions was possible because bidders could submit several offers in a single round. For example, following the first offer in the round which was positive for the buyer as compared with the seller's last offer in the previous round, the seller could submit in the same round offers which yielded negative concession for the buyer. In 6% of cases bidders submitted win-win (negative-positive) offers. In auctions, 9% of concessions were positive for a buyer and null- or negative-type for a bidder.

In the negotiations the sellers' negative-positive concessions were less frequent (1% in cooperative

and 1% in competitive negotiations) than in auctions. The likely reason is different information that is available to sellers in auctions and in negotiations. Sellers know that the auction mechanism allows them to make progressive offers and they are able to select an offer that meets this condition and yields maximum utility for them. Also, they are informed which offer is the winning offer so they can adjust their offers. In negotiations, the mechanism is replaced by the buyers whore rarely inform sellers about the best offer on the table.

Table 7. Categorization of all concessions

Concession-maker:	Concession-taker: buyer (buyer's profit)		
seller (seller's profit)	Positive	Null	Negative
Auctions (total: 784 concessions)			
Positive (%)	560 (71)	18 (2)	27 (3)
Null (%)	27 (3)	8 (1)	6 (1)
Negative	49 (6)	13 (2)	76 (10)
Cooperative negotiations (total: 159 concessions)			
Positive (%)	139 (87)	2 (1)	6 (4)
Null (%)	2 (1)	1 (1)	0 (0)
Negative (%)	1 (1)	1 (1)	7 (4)
Competitive negotiations (total: 157 concessions)			
Positive (%)	135 (86)	3 (2)	8 (5)
Null (%)	2 (1)	1 (1)	0 (0)
Negative (%)	2 (1)	0 (0)	6 (4)

In the negotiations the number of concessions that were not positive-positive was 13% in cooperative and 14% in competitive negotiations. This implies what negotiation theory and practice consider a typical concession, but there are many other types of concession that should not be ignored.

In the negotiations negative-positive (i.e. win-win) concession were observed only in 1% of the cases as opposed to 6% in auctions. In the negotiations cases lose-lose concession (4% for cooperative and 5% for competitive negotiations) were observed more often than in the auctions (3%). While not significantly different, the fact that in negotiations the difference of this type of concessions is small is surprising because the buyers were giving information about their needs and preferences. A possible explanation may be that a portion of sellers was competing.

Negative-negative concessions are *reverse concession* because they make the concession-maker better-off and the concession-taker worse off. A significant per-cent of this category of concessions was made in auctions (10%) and 4% in cooperative and in competitive negotiation. This could be attributed to the possibility of submitting multiple offers in every round of the auctions. The bidders, after making the first offer could submit more offers that were better for them than the first one. In negotiations such an offer may be perceived badly by the buyer who may try penalizing the seller who made it. In negotiations there is no such risk, but there is a chance that one of these offers becomes the winning one.

Null concessions were observed rarely in negotiations (2%) and more often in auctions 5(%). In auctions the majority of null concessions (66%) were positive for the buyer.

The participants were provided with decision aids (including, profit (loss) calculation, offer

generators, interactive and dynamics charts), which they could use in deciding on a concession (Kersten, Pontrandolfo et al. 2012). One may expect that these aids should help negotiators in the process analysis and concession-making. These aids are, however, of limited use if the parties do not exchange relevant information, primarily information about their preferences (profits and losses).

4.3 Observed concession types

Single- and multi-attribute concessions are the two types discussed in Section II. Multi-attribute concessions are cognitively difficult activities in both auctions and negotiations. While such concessions allow for logrolling and hence joint improvements, they also require an assessment of changes caused by two or more attributes. In particular, the seller seeks concessions that may increase the buyer's profit but does not decrease his own profit.

Table 8 show concession types made by winners. We also show the percentage of concession of a given type in the total normalized value of concession. This percentage is calculated based on the total value of concessions normalized for every winner, i.e., 100% of concession value made by every winner was of one or two types. If, for example, the average single-attribute concession value is 40%, then sellers' cessions of this type contributed to 40% of the total concession they made, on average. We call this parameter "concession value contribution" (CVC).

There was only one winner who used solely single-attribute concessions, therefore in Table 8 we show multi-attribute and mixed types of concessions.

Table 8. Winners' single- and multi-attribute concessions

Sellers' average relative concessions (ARC)	Auctions	Negotiations	
		Cooperative	Competitive
Only multi-attribute concessions			
No. of sellers (%)	5 (17)	12 (67)	8 (44)
- CVC multi-attribute	100	100	100
- CVC multi-attribute (buyer)	100	100	100
Winner's profit	-6.6	16.6*	11.5$^{\#}$
Buyer's profit	78.2	57.8*	61.0^
Both single- and multi-attribute concessions			
No. of sellers (%)	24 (83)	6 (33)	10 (56)
- CVC multiple-attribute	66	81	81
- CVC single-attribute	34	19	19
- CVC multi-attribute (buyer)	72	81	85
- CVC single-attribute (buyer)	28	19	15
Winner's profit	-4.5	17.0*	7.3*
Buyer's profit	76.8	56.5*	66.2*

Significance as compared to auctions: *$p < 0.01$; ^ $p < 0.05$;
Significance between integrative and competitive negotiations: $^{+}$ $p \leq 0.005$; $^{\#}$ $p \leq 0.05$.

In the auctions only 17% of winners made only multi-attribute concessions. In the negotiations the picture is different: 63% of the winners in the cooperative and 44% in the competitive negotiations made only multi-attribute concessions. We know of no other studies which would experimentally compare frequency of single- and multi-attribute concessions, therefore we cannot claim that these

frequencies are high in negotiations and low in auctions. The difference between auctions and negotiations is significant and warrants more studies into the reasons.

We also cannot claim that making multi-attribute concessions results in better outcomes. While sellers achieved significantly higher profit in auctions than in negotiations, they did so whether they made only multi-attribute or both single- and multi-attribute concessions. The results shown in Table 8 suggest that it is the mechanism that affects the outcomes, i.e., negotiations are better for sellers and auctions are better for buyers.

Participants who made both single- and multi-attribute concessions showed predisposition for making more of the latter. As before, the negotiators' multi-attribute concessions contributed more to the total value of concessions than those made by the bidders. Those winners who used multi-attribute concessions only were observed less frequently in auctions than in both settings of negotiations. The possible reason is that bidders were able to use a single-attribute concession to correct their first offer made in the round; they could have tried to make offers that were better to them before the round closed.

Those winners who use single-attribute concessions were observed more often in cooperative than in competitive negotiations. A possible explanation is that in competitive negotiations the sellers may engage in trading-off with the buyers on an attribute-per-attribute basis.

When the sellers made two types of concessions, the share (in percentage) of the total average concession value is different in the seller's profit than in the buyer's profit. In our experiments the differences are not significant but their occurrence is interesting. The contribution of multi-attribute concessions to the sellers' total concession value is lower or the same as the contribution to the buyers' concession value. For example, in auctions CVC multi-attribute is 66% of the total concessions measured with the seller's profit function and 72% when measured with the buyer's profit function. This suggests that by making a multi-attribute concession the seller "gives" more to the buyer but concedes less. The opposite is true for the single-attribute concessions. In actions, for example, 34% of CVC measured with the seller's' profits contributed to only 28% of CVC when measured with the buyer's profit.

The use of single-attribute concessions is about half of the multi-attribute ones in the auctions and a quarter in the negotiations. In the auctions this category was mostly used with a round and therefore it had no effect on the profit values. In the negotiations its use was much lower. Given that the above mentioned differences in the CVC measurement in the seller's and the buyer's profit functions were small, the profit values realized when only multi-attribute type and when mixed type were used did not differ significantly.

4.4 Offer generator

We mentioned that making multi-attribute concessions is cognitively difficult. The reason that so many participants made such concessions is that the systems were equipped with an offer generator tool. A user could change attribute values manually and observe the resulting profit value. Alternatively, she could enter a desired profit value and the tool displayed seven alternatives with the same or similar value (Kersten, Pontrandolfo et al. 2012).

In Table 9 we show the number and the percentage of concessions made with and without the generator.

The generator was used significantly more often in auctions than in cooperative and competitive negotiations ($\chi 2(1, n = 942) = 45.531$, $p < 0.001$ and $\chi 2(1, n = 941) = 51.135$, $p < 0.001$, respectively). However, there is no significant difference in the use of the generator by the sellers who participated in the competitive and cooperative negotiations ($\chi 2(1, n = 315) = 0.176$, $p =$

0.675).

Table 9. The use of the offer generator

	Auctions	Negotiations	
Offers made:		Cooperative	Competitive
With generator (%)	372 (47)	29 (18)	26 (17)
Without generator (%)	412 (53)	129 (82)	131 (83)
- Single-attribute concessions w/out gen. (%)	112 (27)	31 (24)	23 (18)
- Multi-attribute concessions w/out gen. (%)	300 (73)	98 (76)	108 (82)

We do not show single- and multi-attribute concessions made with the help of the generator because in this case users considered profit rather than attributes. We show it, however, when offers were constructed without the generator; in this case the users had to change one or more attribute values.

The percentage of single-attribute concessions made without the generator is not significantly different for auctions and cooperative negotiations ($\chi2(1, n = 541) = 0.502, p = 0.478$). However, the percentage of single-attribute concessions made without the generator is significantly higher in auctions than in competitive negotiations ($\chi2(1, n = 543) = 4.931, p = 0.026$). The percentage of single-attribute concessions made without the generator is not significantly different in competitive and cooperative negotiations ($\chi2(1, n = 260) = 1.655, p = 0.198$).

Table 10 shows the impact of the offer generator on the profit achieved by the concession-maker and the concession-taker.

Table 10. Impact of the generator use on outcomes.

	Auctions	**Negotiations**	
		Cooperative	**Competitive**
Winners who did not use generator			
No. (%) of winners	14 (48)	13 (68)	12 (67)
Avg. seller's profit	-1.4	18.5	11.6
Avg. buyer's profit	74.9	54.4	61.4
Winners who used both generator and offer form			
No. (%) of winners	9 (31)	5 (26)	6 (33)
Avg. seller's profit	-4.7	11.2	4.3
Avg. buyer's profit	76.6	64.4	68.8
Winners who used generator only			
No. (%) of winners	6 (21)	1 (5)	0 (0)
Avg. seller's profit	-13.0^#	31.0	-
Avg. buyer's profit	82.8*	47.0	-

Compared to the winners who did not use the generator: * $p \leq 0.01$, ^ $p \leq 0.05$;
Compared to the winners who used the generator and formulated an offer form: # $p \leq 0.05$.

Those winners in auctions who did not use the generator achieved a profit (-1.4) that was not significantly different than the one achieved by the winners who used both the generator and the formulated offer form (-4.7; $p = 0.383$). The buyers' profit does not significantly differ either (p = 0.607).

Those winners who used the generator only achieved significantly ($p = 0.015$) lower profit (-13.0)

than the winners who did not use the generator (-1.4). The buyers' profit was significantly higher (p = 0.01) for the winners who used the generator only (82.8) than for the winners who did not use the generator (74.9).

Those winners in auctions who used the generator only achieved a significantly lower (p = 0.036) profit (-13.0) than the winners who used both the generator and the formulated offer form (-4.7). The buyers' profit was not significantly different for those two groups (p = 0.123).

In both negotiation settings the number of winners who used the generator only is not sufficient for an analysis.

In the cooperative negotiations the difference in the achieved profits between the winners who used the generator only and the winners who used both the generator and the formulated offer form is not significant (p = 0.128 for sellers profit; p = 0.094 for buyer's profit).

In the competitive negotiations the difference in the achieved profit between the winners who used the generator and other winners is not significant (p = 0.119 for sellers profit; p = 0.147 for buyer's profit).

5. Conclusions

The importance of concession-making in both auctions and negotiations is unquestionable. This paper proposes two distinct categorizations of concessions and empirically shows that, if allowed, all nine categories and two types are employed in reverse auctions and in multi-bilateral negotiations.

We found that sellers in auctions make many more concessions than sellers in negotiations. Moreover, the average concession per offer in auctions is greater than in negotiations. The total value of concessions was, therefore, significantly greater in auctions. Consequently, auction winners ended up with significantly worse agreements than the winners in negotiations.

One explanation for this result is the auction mechanism which imposes more constraints on the permissible offers 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 to use concessions as means of eliciting reciprocal steps from the buyers. Thus, the average concessions by the seller may be smaller, and the outcomes are relatively more favorable.

Another possible explanation is the buyers' active participation in negotiations but not in auctions. This participation allows the sellers to explain their needs and ask for better contract conditions. In negotiations buyers can make offers which could be considered as buyer's' aspiration levels by sellers. Knowing this level may prevent sellers from making offers lower than the buyer's offers, which might result in higher outcomes.

Based on these results, one may conclude that buyers prefer employing reverse auctions in procurement because they can extract more from sellers. Such a conclusion is only partially correct for two key reasons: (1) There are situations in which both buyers and sellers have interests (e.g., relationship and commitment) in the value which cannot be determined through an auction; and (2) There are goods and services which need to be negotiated because their specification cannot be determined a priori. Therefore, both reverse auctions and multi-bilateral negotiation have been used in procurement (Kraljic 1983; Handfield and Straight 2003).

Kersten, Pontrandolfo et al. (2012) reported that the difference between average concessions by the sellers in negotiations when comparing competitive vs. cooperative buyers was not significant and that win-win offers were observed more often in auctions than in negotiations. Here we can

add that win-lose and other categories of offers occur in auctions if the protocol allows it.

This experiment also shows that using single-attribute concession does not significantly change the achieved outcomes either in auctions or negotiations. This is troublesome because single-attribute offers are an indicator of a competitive tactic while multi-attribute offers indicate cooperative tactic (Weingart, Hyder et al. 1996; Raiffa, Richardson et al. 2003). Making single-attribute offers is cognitively easier and makes the process easier to control but the offer generator should reduce these difficulties. The fact that this did not happen requires further investigation

Another puzzling result is the use of the offer generator. We have no answer why the generator was used significantly more often in auctions than in negotiations. The generator focusses users on the value (profit, loss) of the complete offer. If a user considers only one attribute and does not want to analyze other attributes, then the generator may increase rather than decrease cognitive load. A possible and troubling explanation is that participants were more concerned with making concessions than with assessing their implications.

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