InterNeg

InterNeg Research Papers INR11/12

Revised version appeared in: ***System Sciences (HICSS), 2013 46th Hawaii International Conference***, vol., no., pp.538 -547, 7-10 Jan. 2013

Sellers' Objectives in E-procurement Auction and Negotiation Experiments

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Abstract

Participants of economic transactions are assumed to make decisions based on objective directly related to the transactions. This paper shows that, aside from biases and cognitive limitations, they may have also other objectives. Using online and lab e-procurement experiments with reverse auctions and multi-bilateral negotiations we confirm results reported earlier for the case of bilateral negotiations, namely that, respectively, three and four types of objectives can be identified. Based on the objectives' importance distinct groups of participants are identified; they differ in their behavior and the outcomes they achieve. The results indicate some bidders and negotiators want to achieve objective other than substantive and are willing to trade off the latter for relational objectives.

Acknowledgments: The publication of the InterNeg Research Papers has been supported by the Natural Sciences and Engineering Research Council, the Social Sciences and Humanities Research Council, and the J. Molson School of Business, Concordia University.

1. Introduction

Decision-making has a purpose; it is undertaken so that the implementation the selected decision advances one or more objectives of the decision-maker. Rational decisions require that there either be a single objective or, in the case of multiple objectives, they be neatly represented by a single (utility) function. The selected decision is one that optimizes the objective or utility value. In reality, people tend to violate rationality principles and consider objectives which are not directly related to the decision problem and the decision itself. They follow rules of reciprocity, make choices based on altruism, affect, envy, and fear, and are also concerned with the opinion of the others with whom they are directly or indirectly associated. In such situations they may violate a narrowly defined and mechanistic rationality principle but yet be rational in their effort to consider various objectives when making a decision [1, 2].

The various objectives that underlie human decision making also occur in business transactions because a single transaction may have both short- and long-term implications. Negotiations between representatives (agents) of two organizations may lead to strengthening of their relationship and building trust (but they may also introduce distrust and search for other business partners [3]. There are also other types of business transactions in which the non-economic objectives should not play a role; these are market-based mechanisms, foremost the posted price and auctions.

Economists observe that auctions often do not result in the winning bid conforming to the theory (Nash equilibrium); the "winner's curse" is a well-known phenomenon [4, 5]. The main reasons for winner's curse are: (1) the uncertainty of the value of the good; (2) inexperience of the bidders; (3) cognitive bias; (4) failure to take into account the rules of the mechanism; and (5) failure to utilize available information.

Experiments show that the winner's curse may be reduced, but not eliminated, by giving bidders more experience [6, 7]. One may argue that in experiments participants bid aggressively and often overbid because of their limited liability for losses [8]. This argument was refuted [9], however, the discussion on the experiment participants' motivation is ongoing and remains inconclusive [see, e.g., 10, 11, 12]. Gneezy and Rustichini [13] observed that the effect of monetary compensation is non-monotonic and contingent on other motivations, including intrinsic. This means that the participants may have other objectives, than the achievement of the monetary rewards.

Wu et al. (2012) studied objectives of participants of e-negotiation experiments. Based on a pilot study followed by an exploratory analysis they observed that all participants considered several objectives as important or very important. In this paper we discuss the objectives of participants who use exchange mechanisms for e-procurement. The mechanisms are multi-attribute reverse auction and multi-attribute multi-bilateral negotiation. They can be used to award contract in the same business situation and they differ in the involvement of the buyer during the decision process. In negotiations the buyer directly interacts with multiple sellers and in auctions the buyer sets the parameters while the sellers compete among themselves.

The results obtained by Wu et al. (2012) concern bilateral negotiations of about three weeks duration. During this time the parties may establish closer relationship and become concerned with the non-economic aspects of the process. Because there is no competition, they have to either accommodate each other's needs or terminate the negotiation.

In this paper we consider market-based exchanges, in which the sellers compete in order to obtain a contract; there is only one contract to award. The two questions we address are: (1) Do multiple sellers have different objectives when they have to compete than when each seller negotiates with one buyer? (2) What are the differences in terms of sellers' objectives when they engage in auctions and in multi-bilateral negotiation?

The paper has 5 more sections. Because we know of no studies which specifically address bidders' objectives, we discuss in Section 2 negotiators' objectives as they were observed in literature. The two experiments which we conducted are discussed in Section 3. Because Wu et al (2012) analysis was done in different negotiation settings we repeated exploratory factor analysis; the results are presented in Section 4. In Section 5 the results of confirmatory factor analysis are given. Discussion and future work is given in Section 6.

2. Negotiators' objectives

Negotiation literature recognizes two types of outcomes: substantive and relational [14-16]. Substantive outcomes are the content of the agreement - in business transactions they are the economic results. Relational outcomes describe the change of the relationship between the negotiators (e.g., empathy, trust and dependency). They are the result of the communication process and the agreed substantive outcomes. The focus on substantive outcomes is behind the often stated concern about agreements being efficient and value not being left on the table [17]. Early on, scholars recognized the significance of relational outcomes, hence objectives describing aspects of a relationship which the negotiators wish to achieve, however, most studies do not consider perceptual and altitudinal measures [18].

Curhan et al. [15] studied the subjective values of concern for negotiators. Based on a validated questionnaire they identified subjective values which are important. These values are associated with the following types of feelings:

1. Feelings about the substantive outcomes;
2. Feelings about the self;
3. Feelings about the process; and
4. Feelings about the relationship.

These four types suggest that negotiators may pursue several objectives some of which are not associated with the achievement of substantive outcomes. Some of the feelings cannot be, however, directly converted to objectives which guide behavior because they are means rather than ends. For example, feelings about substantive outcomes depend on the outcomes; hence the objectives describe these outcomes' achievement rather than feelings about them.

Curhan et al. [15, p. 507] note that the biggest limitation of their research is the consideration of what the negotiators say they value rather than what they actually value. Wu et al. [19] employed a questionnaire in negotiation experiments which allowed them to study the relationship between the objectives' importance as it was stated by the negotiators, their behavior during the process and the results they obtained. They also included a category of objectives which was not included by Curhan et al. [15], yet in many situations negotiators may view it as very important. These objectives describe the relationship between the negotiators and the organization or group of people that they represent.

The participants of negotiation experiments play a role and in the capacity of this role they are typically asked to achieve substantive outcomes. When the experiments involve students, the students are often required to do the experiment as a part of a course. This requirement may be seen as a proxy for negotiators being engaged on behalf of an organization. Sales and procurement managers may be on a salary system and the outcomes they negotiate contribute to bonuses and other rewards.

Professionals for whom negotiation is a part of their work may be interested in becoming better negotiators and strengthening their professional position. Objectives associated with learning and position may be of particular importance for students who expect to participate in negotiations in the future.

Given the above Wu et al. [19] designed a 13 item questionnaire to decide on the importance of four types of objectives: (1) Substantive; (2) Relational; (3) Learning; and (4) Practice. The exploratory factor analysis showed that three factors identified corresponded to three types of objectives: substantive, relational and study. The total variance accounted for is 61.2%, indicating an adequate factor structure for self-reported scales. Additionally, all, except for one, factor loadings were above 0.50. Objectives associated with practice were not identified as a separate factor. One reason may be that these objectives were considered important or very important by almost all participants.

The three identified objectives had significant effect on the negotiators' aspirations and reservations, their behavior during the process (i.e., opening offer, number of offers and messages, and the length of messages) and the agreement utility.

Cluster analysis of the objectives' importance allowed Wu et al. (2012) to distinguish five profiles of the participants. Significant differences between the five groups in terms of expectations, behavior and outcomes, except for aspiration level and message length, were observed across the five profiles.

3. Auction and negotiation experiments

To study the types of objectives used in auction and negotiations and their impact on the transaction process and its outcomes we conducted an experiment in the Fall 2011.

3.1 Settings

The experiment was conducted in two settings -online and in the lab. Online experiments took 10 days while in the lab the participants were given 2.5 hours to complete their activities. This time included reading the task and filling out questionnaires. The participants of the online section had 10 days for the same activities.

Within each of these experiments participants were asked either to play a role of sellers or buyers in multi-bilateral negotiations; or a role of sellers in multi-attribute reverse auction. In negotiations sellers were able to exchange messages and offers with a buyer. Each buyer conducted negotiations with a number of sellers varying from three to five. In each auction there were between three and five bidders. We used two settings for auction mechanism - one when all bids were shown to all bidders, the other when only winning bids of each round were shown.

3.2 A 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 corresponded 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 differed; their breakeven points at which profit turns into losses also differed. Consequently the sellers had different theoretical chances of getting the contract.

We used two versions of the business case in the experiment, one with 216 and another with 3375 alternatives.

3.3 Questionnaire

The sellers obtained a questionnaire comprising the following 12 questions; three for each of the objective type (S – substantive; R – relational; L –learning; and P – practice), The questions are shown in Table 1; the answers were given using the 1-7 Likert scale, from "Not important at all" to "Extremely important".

Table 1. Questionnaire

1.	Achieving the highest possible rating for the agreement. (S)
2.	Trying to achieve the best possible agreement. (S)
3.	Obtaining the best results for the company I represent. (S)
4.	Acquiring knowledge which is necessary for course work.(L)
5.	Learning what I must in order to complete my assignment. (L)
6.	Obtaining information which is useful for my assignment. (L)
7.	Practicing my negotiation skills. (P)
8.	Improving my negotiation skills.(P)
9.	Preparing for real-life negotiations. (P)
10.	Establishing a friendly atmosphere with my partner. (R)
11.	Achieving results that are good for both my negotiation partner and myself. (R)
12.	Building a good relationship with my partner. (R)

In the auction experiment we decided to remove the relational questions (10-12) and ask only questions 1-9. The reason is that in the negotiation the sellers communicate directly with the buyer exchanging offers and messages. Therefore, they are able to establish a relationship. In an auction, however, they cannot learn anything about the buyer except for the general information that is available to all. They cannot interact with or learn anything about the buyer hence they cannot change any relational variable.

3.4 Descriptive statistics

The experiment involved over six hundred students from Canada, Austria, USA, Poland and Taiwan. The majority of negotiation sellers and auction bidders were first-year undergraduate students; graduate students were asked to play the role of negotiation buyers. There were 284 students participating in negotiations and 381 in auctions. After validation of the questionnaire data collected in the experiment, 20 students were removed from the negotiation dataset, Consequently, 262 data points were usable.

Table 2 gives a demographic portrait of participants, their expectation of the task difficulty and their aspiration and reservation levels. These two levels describe, respectively, the rating of the agreement which they expect to achieve and a minimum rating which they consider acceptable. The rating values range from 0 to 100.

Table 2. Descriptive statistics

	Negotiation	Auctions	All
No. of students	262	381	
Demographics			
Age group (<=25)	91.6	91.6	91.6
Gender (Female)	55.0	48.8	51.3
English skill (good or excellent)	84.4	77.9	80.5
Knowledge of negotiations (Low)	39.7	35.2	37.0
Experience (No)			
System	76.0	86.4	82.1
Task	81.7	90.6	86.9
Expectations			
Task difficulty	3.8	3.9	3.9
Aspiration level	56.5	59.1	58.1
Reservation level	31.8	30.2	30.9

Some auctions and negotiations did not conclude because no bids or offers were made, or all participants in an instance dropped out after making initial bids (offers). In order to compare the objectives with the outcomes completed auction and negotiation processes were required. After reviewing the experiment flow and removing all empty negotiation and auction instances, we obtained data from 78 negotiation and 70 auction instances. In these instances there were 228 negotiation sellers and 218 auction sellers which allowed us to analyze outcomes and their relation to objectives.

The experiment was conducted in seven treatments with different mechanisms (auction and negotiation), settings (online and lab), number of alternatives (216 and 3375), and two types of information revelation in auctions (display of either the winning bid only or all bids).

4. Exploratory factor analysis

Wu et al. (2012) conducted a pilot study followed by an exploratory factor analysis of the instrument presented in Table 1. After making some minor adjustments, we used the same instrument in multi-bilateral negotiations and a truncated one in multi-attribute reverse auctions. To check if the four factors identified by Wu et al. (2012) we also conducted factor analyses; their results are discussed in this section.

4.1

The results of the exploratory factor analysis (maximum likelihood with oblimin rotation and Kaiser Normalization) for the negotiation experiments are shown in Table 3.

Table 3. Factor analysis results for negotiations

	Relational	Practice	Substantive	Study
Relationship	**1.05**	-0.08	0.03	-0.08
Atmosphere	**0.66**	0.11	0.00	0.06
Good-for-both	**0.42**	0.09	0.07	0.23
Practice-skill	0.05	**0.81**	0.07	-0.03
Real-life	0.02	**0.76**	0.07	-0.08
Improve-skill	-0.02	**0.67**	-0.06	0.30
Agreement	0.04	-0.07	**0.77**	0.02
Rating	0.02	0.07	**0.69**	-0.05
Company	-0.05	0.08	**0.64**	0.13
Must	0.04	0.05	0.08	**0.68**
Information	-0.02	-0.03	0.08	**0.67**
Course-work	0.19	0.13	0.02	**0.46**
Eigenvalues	5.15	1.18	0.95	0.77
Explained var.	47%	11%	9%	7%

We should point out that some of the factor loadings are low, in particular loadings on item Good-for-both (Question 11 in Table 1) and Course-work (Question 4 in Table 1). There are also two instances of cross-loading exceeding 0.2. Furthermore, the eigenvalues of two factors are below 1 (i.e., 0.95 and 0.77) which contributes to their low values of explained variance (i.e., 9 and 7%). The overall explained variance is high (73.1%).

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