Predicting Bargaining Behavior When Money Is Not All That Matters: The Role of Fairness Considerations in Shaping Price Agreements

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PREDICTING BARGAINING BEHAVIOR WHEN MONEY IS NOT ALL THAT MATTERS: THE ROLE OF FAIRNESS CONSIDERATIONS IN SHAPING PRICE AGREEMENTS

Abstract – In bargaining situations, buyers and sellers do not gauge offers solely at the light of their self-interested material gains, but also seem to take into account non-monetary considerations such as fairness or reciprocity. This paper attempts to quantify these non-monetary motives in a buyer-seller context. We fit a model to a simple negotiation game data to quantify the role of fairness considerations in negotiation behavior, and then use the model to obtain out-of-sample estimates of play in more complex, sequential negotiation games. The model embeds a social utility function, a probabilistic decision rule, and captures experience effects. The out-of-sample test data comes from 6 previously reported studies, encompassing 20 distinct parameterizations of the sequential negotiation game. The model is remarkably accurate with respect to directional findings and to out-of-sample estimates of average first offers, accounting for 95% of the variability in the data. Out-of-sample estimates of rejection behavior account for more than half the variability. The results suggest that the influence of non-monetary considerations on bargainer decision can be reliably quantified to predict negotiations outcomes.

Keywords – Price negotiations; Bargaining behavior; Social utility

INTRODUCTION

The role of non-monetary considerations –such as fairness– in shaping price agreements has recently received considerable attention in the bargaining and marketing literature (Xia et al. 2004). When marketers think of 'fairness', however, they think of a soft variable, one resistant to robust measure. Knowing something about the ordinal effects of fairness may be useful, but the more exacting, quantitative prediction of behavior requires a reliable quantitative measure of fairness.

This paper investigates the quantitative stability of fairness in the context of price negotiations, that is, whether or not fairness considerations can be reliably quantified to provide accurate predictions of price negotiation outcomes in various bargaining situations.

We first calibrate the quantitative role of fairness by fitting a social utility model, cast in a Logit response framework that accounts for noise and experience, to ultimatum bargaining game data. Our intuition is that, if properly accounted for, fairness considerations are stable enough to offer reliable behavior predictions in various situations. We then derive fully out-of-sample estimates of offer and rejection behavior for multiple round sequential negotiation games and compare with observations culled from several different studies.

All of the data investigated here come from the standard sequential bargaining games which, like the ultimatum game, are finite with buyers and sellers having complete information about monetary payoffs and discount factors. There are a buyer and a seller, α and β, looking to come to agreement on the split of a bargaining pie of size c (e.g., to divide the profits of an operation). The game is divided into n rounds. In the first round, α proposes a split to β, summarized by 1-σ, the proportion of the pie he proposes to keep, offering σ to β. If β accepts, the pie is divided accordingly. If β rejects, the pie shrinks by discount factors (δ_α, δ_β) which represent disagreement costs. The negotiation then proceeds to the second round and roles are reversed with β making the proposal. The negotiation proceeds in this fashion until the last round, in which, absent agreement, the negotiation ends with both bargainers receiving nothing. The ultimatum game is the one round version of the game.

Although sequential bargaining games are stylized games, and do not aim at capturing the complexity of real-life bargaining situations, they offer several advantages for the application at hand. First, sequential bargaining games have been extensively studied, especially in game theory, and the many studies available offer an ideal test bed for out-of-sample exercises. In addition, the sequential bargaining procedure is such that many 'external' factors that could potentially explain bargaining behavior are excluded by design (e.g., negotiation powers, relationship history), hence providing a 'purified' environment for theory testing.

All told, our data derives from 7 studies, conducted by as many research teams, encompassing 21 distinct parameterizations of the sequential bargaining game, representing 2,669 observations from 901 participants. The differences across these studies in terms of data is such that, at the time, the researchers involved reached markedly different conclusions concerning the ability of game theory to predict bargaining behavior. The studies also differ substantially with regard to procedures, subject pools and stakes; in fact some observers conjectured that the design differences were primarily responsible for the differing data and conclusions. We show in this paper that most of the results can be replicated out-of-sample when bargainers' non-monetary considerations are taken into account.

THE MODEL

Social utility function

We capture fairness considerations using an ERC (Equity-Reciprocity-Competition) social utility specification originally suggested by Bolton and Ockenfels (Bolton and Ockenfels 2000). Bargainers care about both absolute (pecuniary) and relative (fairness) payoffs with relative payoffs characterized by a loss of utility as bargaining outcomes move away from equity. The social utility function we use is adjusted to the asymmetry suggested by Bolton's (Bolton 1991) comparative bargaining model: bargainers' utilities only diminish when the deal is unfair to them, not when it is unfair to the other bargainer. The function is illustrated by Figure 1.

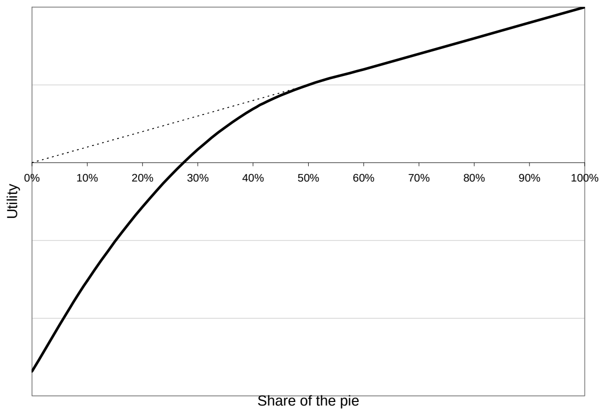

Figure 1 – The ERC social utility function incorporates fairness considerations by introducing a loss in utility when a bargainer receives less than half of the pie, that is, less than what the other bargainer receives. This loss in utility is fit by a single parameter *b*, to be estimated. Among other issues, this paper investigates whether this parameter is stable enough across bargaining situations to offer reliable out-of-sample predictions.

$$U(\sigma) = \begin{cases} c\left(\sigma - \frac{b}{2}\left(\sigma - \frac{1}{2}\right)^2\right) & if \quad \sigma < 1/2 \\ c\sigma & if \quad \sigma \geq 1/2 \end{cases}$$

Equation 1 – Social utility function. *c* is the size of the pie, σ the proportion of the pie the bargainer gets, and *b* measures the loss of utility engendered by unfair offers.

Decision making framework

We cast bargainer decision making in a Logit response framework (McKelvey and Palfrey 1995), and solve for perfect Bayesian equilibrium (i.e., using backward induction.) One of the basic assumptions of most mathematical learning theories proposed in psychology is that choice behavior is probabilistic. Consistent with this, Logit response permits "mistakes" with respect to the optimal decision. Propensity to make such mistakes are estimated through the scale parameter τ, that we call *coefficient of certitude*. It is an indicator of individuals' choice consistency. The larger τ, the higher the probability the bargainer follows the strategy that produces the highest utility. This coefficient is hypothesized to linearly increase with experience, that is, $\tau = \tau_0 + \tau_1 g$, where g is the number of games played. Experience effects are then equated with a diminishing of mistakes over time.

For illustration purpose, we cast the model in terms of the ultimatum game; application to multiple round sequential offer games is transparent. Let express $P_\beta(\sigma_i)$, the probability that the seller β accepts an offer of proportion σ_i of the pie, by a Logit model:

$$P_\beta(\sigma_i) = \frac{e^{\tau_\beta . U(\sigma_i)}}{1 + e^{\tau_\beta . U(\sigma_i)}}$$

Equation 2 – Sellers' probability to accept an offer of σ_i.

where $U(\sigma_i)$ is the utility of accepting the offer, calculated from equation 1.

Consistent with the perfect Bayesian equilibrium, we suppose that proposers know the true probability sellers to accept any particular offer, and hence the true expected utilities of such offers. Proposers' decisions are therefore casted in a similar Logit decision model. It follows that the offers with the highest expected utilities are likely to be chosen more often.

ESTIMATING THE PARAMETERS OF THE MODEL FROM THE ULTIMATUM GAME DATA

The model has three parameters to be estimated: *b*, the unique parameter of the utility function, and τ_0 (intercept) and τ_1 (experience effect), the two parameters that drive bargainers' coefficients of certitude.

We fit the model to the multi-country bargaining experiment conducted by Roth et al. (1991) using maximum likelihood estimation. The parameter estimates we obtained are:

b=10.742 (.995) τ_0=.3478 (.0189) τ_1=.0159 (.0038)

All parameters have the expected sign, and are significant at p<.01. As to the fit, the model predicts that the average offer will be 40.6% of the pie, with an average rejection rate of 30.9%. These numbers are actually 40.7% and 26.4% in the original dataset. Student t-tests at $p<0.05$ on these two measures cannot reject, confirming a good statistical fit. The correlations between observations and predictions are high, with R_α=.907 and R_β=.973. The fit can also be examined in the following figures:

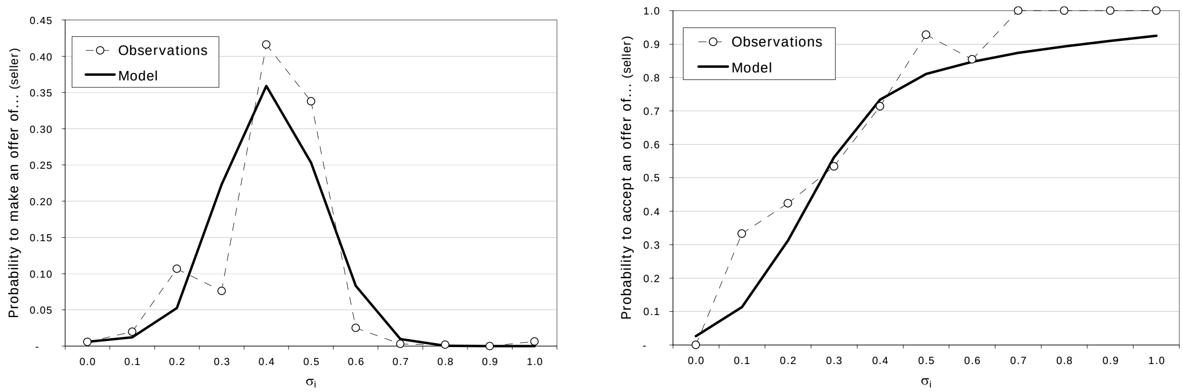

Figure 2 – Left: Probability for the buyer to make an offer of σ_i: Right: Probability for the seller to accept an offer of σ_i: Observations *(from Roth et al., 1991)* vs. model.

The model predicts a large disutility of accepting unfair offers, disutility that drives results away from the Nash equilibrium. When responders are offered an unfair split of the pie, their likelihood of accepting the offer diminishes dramatically. Specifically, the model predicts that responders are more likely to reject an offer (and hence having nothing) than to accept an unfair offer that lefts them less than 25% of the pie.

OUT-OF-SAMPLE TEST OF SEQUENTIAL BARGAINING GAMES

The sequential bargaining data we examine to assess the out-of-sample predictive ability of our model encompasses all of the early, baseline studies reviewed in Roth's "Bargaining" chapter of the *Handbook of Experimental Economics* (Roth 1995), plus a more recent 3-person bargaining experiment from Güth and van Damme (Binmore et al. 1985; Bolton 1991; Güth and Tietz 1988; Güth and van Damme 1998; Neelin et al. 1988; Ochs and Roth 1989). Altogether, our sample encompasses 6 studies with a total of 601 participants and 20 treatments, for 1,319 observations. The data encompasses a good deal of diversity with respect to game parameters, including pie size, discount factors, and number of rounds (see appendix, table 1), providing a good test bed for out-of-sample testing.

Despite the variety of experimental conditions, out-of-sample predictions are remarkably accurate, especially with regard to buyers' behavior. Depending on the specific games played, the model predicts that mean opening offers will range between 7.0% and 57.2% of the pie. Observations range between 6.5% and 65.3% (see appendix for details.) Pearson's coefficient of correlation for the mean opening offer is R_{offer}=.90. When taking into account games that were played more than once, hence incorporating experience effects, this figure goes up to R_{offer}=.95. By comparison, predictions based on the pecuniary model of game theory (Nash equilibrium with no fairness considerations) only achieves R_{offer}=.38.

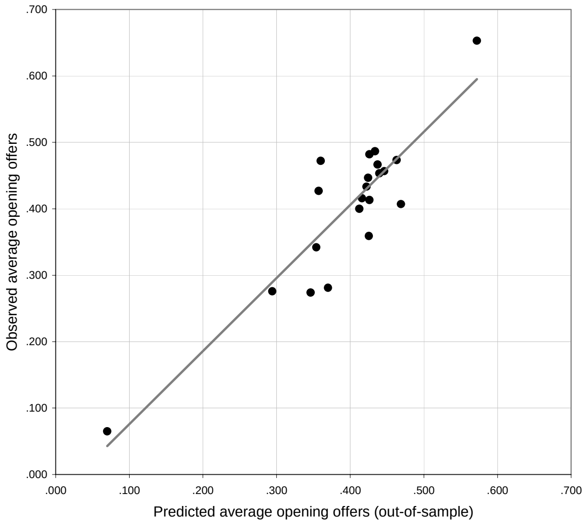

Figure 3 – Average opening offers in 20 different sequential bargaining games, model predictions vs. observations. Despite the wide variety of games (two-, three- and five-round, truncated and three-person games), bargaining stakes and discount factors, predictions are remarkably accurate, including for games where 'extreme' behaviors are observed.

With regard to disagreements, the model predicts average rejection rates between 13.0% and 55.1%, depending on the experimental conditions. Observations range between 5.0% and 61.9%. Pearson's coefficients of correlation are R_{reject}=.37 across all games, and R_{reject}=.51 for games played more than once. In contrast, Nash equilibrium considers rejections impossible.

CONCLUSIONS

In this paper, we have developed a utility-decision framework to predict bargainers' behaviors in various stylized negotiation situations. Noticeably, the model does not rely upon any kind of prior knowledge about initial bargainers' expectations or utilities or propensities to play certain strategies, and partly addresses the lack of quantification usually encountered in the social utility literature. Its remarkable generalization properties and predictive ability open the way to the systematic quantification and prediction of the role of non-monetary considerations in buyers and sellers behaviors.

This paper also lays the groundwork for more sophisticated models, with possible applications in domains such as price negotiations with asymmetric power, the role of perceived costs and benefits (when bargainers do not have the same perception of the size of the pie), or the impact of equity consideration in the stability of business alliances.

Specifically, it seems possible to fit this model to past data of, say, a specific industry, and use the results to predict future negotiation outcomes. The integration of this model as a part of a more complex, salesforce decision support system opens the way to intriguing future research, too.

APPENDIX

Experiment	#	Pie size	Rounds	Discount factors	Times played	Offer		Rejection	
						Data	Model	Data	Model
Roth, Prasnikar, Okuno-Fujiwara and Zamir (1991)	1	$10 or $30	1	n/a	10	0.407	0.406	0.264	0.308
Binmore, Shaked and Sutton (1985)	1	100 pence	2	(.25, .25)	1	0.416	0.416	undisclosed	
Güth and Tietz (1988)	1	5 to 35 DM	2	(.10, .10)	1	0.281	0.370	0.190	0.381
	2	5 to 35 DM	2	(.90, .90)	1	0.427	0.357	0.619	0.551
Neelin, Sonnenschein and Spiegel (1988)	1	$5	2	(.25, .25)	1	0.274	0.346	0.225	0.506
	2	$5	3	(.50, .50)	1	0.472	0.360	0.050	0.524
	3	$5	5	(.34, .34)	1	0.342	0.354	0.125	0.514
	4	$15	5	(.34, .34)	4	0.359	0.425	0.156	0.281
Ochs and Roth (1989)	1	$30	2	(.40, .40)	10	0.413	0.426	0.100	0.130
	2	$30	2	(.60, .40)	10	0.487	0.434	0.150	0.167
	3	$30	2	(.60, .60)	10	0.473	0.463	0.188	0.202
	4	$30	2	(.40, .60)	10	0.457	0.446	0.200	0.170
	5	$30	3	(.40, .40)	10	0.433	0.422	0.120	0.137
	6	$30	3	(.60, .40)	10	0.447	0.424	0.140	0.164
	7	$30	3	(.60, .60)	10	0.453	0.440	0.144	0.226
	8	$30	3	(.40, .60)	10	0.467	0.437	0.289	0.180
Bolton (1991)	1	$12	2	(.67, .33)	8	0.400	0.412	0.188	0.328
	2	$12	2	(.33, .67)	7	0.482	0.426	0.184	0.335
	3	$12	Trunc.	(.67, .33)	8	0.407	0.469	0.391	0.370
	4	$12	Trunc.	(.33, .67)	8	0.653	0.572	0.266	0.535
Güth and van Damme (1998)	y	DG 24	3-person	n/a	6	0.276	0.294	0.079	0.281
						0.065	0.070		

Table 1 – Summary of the experimental designs, observations and predictions for the bargaining studies; data used to fit the model (row 1) and out-of-sample tests (rows 2 to 7).

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