Deadline Effects in Sequential Bargaining

- An Experimental Study -

Werner Güth[*], M. Vittoria Levati[†], Boris Maciejovsky[‡]

Abstract

This paper reports on an experiment designed to explore the robustness of the deadline effect in multi-period structured bargaining games using constant and decreasing pies, different time horizons, and both constant and alternating role modes. Our results indicate that decreasing pies and alternating roles lead to earlier agreements (i.e., attenuate the deadline effect) although only alternating roles significantly reduces the number of conflicts.

Keywords: Ultimatum game, Deadline effect, Conflict resolution, Decreasing pie

JEL classification: C70; C90; D74

[*]Max Planck Institute for Research into Economic Systems, Strategic Interaction Group, Kahlaische Strasse 10, D-07745 Jena, Germany. Tel.: +49/3641/686-620, Fax: +49/3641/686-667, e-mail: gueth@mpiew-jena.mpg.de

[†]Max Planck Institute for Research into Economic Systems, Strategic Interaction Group, Kahlaische Strasse 10, D-07745 Jena, Germany. Tel.: +49/3641/686-629, Fax: +49/3641/686-666, e-mail: levati@mpiew-jena.mpg.de

[‡]Max Planck Institute for Research into Economic Systems, Strategic Interaction Group, Kahlaische Strasse 10, D-07745 Jena, Germany. Tel.: +49/3641/686-626, Fax: +49/3641/686-666, e-mail: maciejovsky@mpiew-jena.mpg.de

1 Introduction

Imagine a situation in which parties bargain about the allocation of a reward. In the tradition of non-cooperative bargaining (Nash 1953), such negotiation adheres to a rigid bargaining model specifying how parties allocate the total reward between them. One explicit aspect of the bargaining environment pertains to the timing of negotiations, which is usually captured by the introduction of sequential bargaining protocols or multiple negotiation periods (early and influential contributions are Harsanyi & Selten 1972, Stahl 1972, Rubinstein 1982). One characteristic feature of such bargaining environment is that negotiation is time restricted by the presence of a deadline. If parties delay and shift agreements toward the deadline, such tendency is referred to as the "deadline effect".

Deadline effects have been subject to numerous theoretical and empirical studies over years.[1] Yet, conclusive and satisfactory explanations for why they occur and what features of the bargaining environment might prevent them are lacking.[2] Roth et al. (1988), for instance, study the distribution of bargaining agreements over time and find strong evidence of a deadline effect. They view the phenomenon as quite robust (in the sense that the distribution of agreements does not respond to changes in the bargaining environment as sensitively as other aspects of bargaining do), and conclude that understanding why the deadline effect occurs "is likely to have practical implications about the design and conduct of negotiations, and may also shed further light on the causes of bargaining inefficiencies" (Roth et al. 1988, p. 822).

[1] See, e.g., Roth, Murnighan & Schoumaker (1988), Fershtman & Seidmann (1993), Sterbenz & Phillips (2001), Gneezy, Haruvy & Roth (forthcoming).

[2] Incomplete information is often used to explain delays in bargaining agreements (Fudenberg & Tirole 1983, Fudenberg, Levine & J. 1985, Hart 1989, Rubinstein 1985). See Roth & Ockenfels (2002) for a discussion of the multiple causes of last minute bidding on eBay.

This paper reports on an experiment designed to explore the robustness of the deadline effect and identify which features (if any) of the bargaining environment may prevent it. In particular, we concentrate on three issues that can account for delaying agreements and the occurrence of conflicts: the length of the bargaining horizon, the shrinking of the pie, and whether or not proposer (and responder) roles alternate during bargaining. We assume that role alternation is perceived as "procedurally fair" by the bargaining parties.

Previous studies of the distribution of agreements over time have usually been based on free format bargaining in real time. Such a format involves the risk of random delays in the transmission of proposals: There can be some unanticipated delay in moving offers and counteroffers back and forth between parties. In other words, the exact length of the chain of (counter)offers is uncertain: As the deadline is approached, there is an increasing probability that bargaining ends before additional proposals can be made.

To exclude the influence of random delays on the bargainers' behavior and study the deadline effect in isolation from other interfering (external) factors, we decided to impose rigid rules specifying *who* makes a proposal and *when* the proposal is made. Hence, our experiment is rooted in the tradition of the (dynamic) non-cooperative approach to bargaining as postulated by Nash (1953) and most elegantly realized by Rubinstein (1982): Time deadlines are here discretized and bargaining takes place over time according to a predetermined procedure of alternating offers and responses of the parties.[3] By such means, we can concentrate exclusively on the deadline effect and investigate if, and how, the agreements' timing changes dependent on experimental conditions, precluding confounding

[3] A large number of previous experiments focus on multiple-period structured bargaining games. See Güth (1995), and Roth (1995) for surveys.

effects provoked by unanticipated random delays.[4]

Earlier sequential bargaining experiments usually assume very few negotiation periods (see, e.g., Roth 1995 for a collection of representative work). Yet, in several natural bargaining situations, parties can often exchange many offers to reach a final agreement. We, therefore, compare negotiations with few periods, as in former studies, to those where many exchanges are possible. Multi-period negotiations are so frequently observed that one does not need to justify why one wants to explore them experimentally. For instance, in private business life, parties usually meet quite often; this might increase the opportunity costs, and thus question the profitability of the final result. On the other hand, the more formal rituals of collective wage bargaining and negotiations involving public authorities allow usually for only a few meetings. But, as negotiations may start before the old contract expires, it may not be harmful to delay the agreement.[5] In our study, we capture the potential relevance of different bargaining horizons by comparing negotiations with at most 3 and 11 periods.

In addition to the horizon of negotiations, the monetary amount at stake may affect whether (and, if so, when) agreements are reached. If the pie, i.e. the amount p_t to be distributed in period t, does not decrease over time, multiple periods of negotiation do not matter much since the same agreements payoffs are feasible earlier and later.[6] Game theoretically the predicted outcome is de-

[4]Sterbenz & Phillips (2001) use a different method of controlling for delays in a free format set-up. They run two computerized bargaining experiments in which all proposals are explicitly randomly delayed, and compare these results to those of an experiment with no such delays. They find that random delays give a significant advantage to the first proposer, and reduce the occurrence of the deadline effect.

[5]Actually, the representatives of trade unions may want to delay agreements to show their members how difficult it has been to reach an agreement and that they have been very tough with the employer side.

[6]Non decreasing-pie games can be seen as the non-cooperative analogue of free format bargaining with no experimentally induced delay costs.

termined by the anticipated behavior in the very last period: The proposer in the last period might hope to capture the lion's share of the pie by making an ultimatum offer, and working back to period 1 reveals that the subgame perfect equilibrium of an ultimatum game gives all (or virtually all) the pie to the last proposer. Under this argument, the deadline effect may result from strategic behavior aimed at creating the conditions to issue an ultimatum. Thus, in multi-period bargaining games with non-decreasing pie explaining the deadline effect seems to be relatively simple.[7]

With decreasing pie, the subgame perfect equilibrium predictions are as clear (and can be nearly as extreme) as in the ultimatum game. But, when the pie is shrinking, the time of the agreement becomes important. Since delaying an agreement is costly, the proposer (in case of constant role games) or both the proposer and the responder (in case of alternating role games) are better off if agreement is reached already in the first period of bargaining.[8] In other words, decreasing pies give the bargainers an incentive to reach an early agreement and question the strategic argument explaining the deadline effect.

By distinguishing between constant and slowly decreasing (10%-decrease of the pie from the first to the last period) pies we are able to explore whether deadline effects are robust to small costs of delay. Do deadline effects apply to non-cooperative bargaining games in case of both no and small delay costs? Or do parties strive for early conflict settlements when delay is costly? Since "decreasing pies" altogether shrink by 10%, the delay costs per negotiation period are rather small in 11-period games and rather high in 3-period games. Thus, implicitly, the horizon length co-determines the delay costs per negotiation period. The

[7]On the straightforward explanation of the deadline effect in finite-horizon games with constant pie see also Gneezy et al. (forthcoming).

[8]Rubinstein (1982) extends the analysis to infinite horizons.

confounding effect is, however, not troublesome since both the long horizon and the short horizon are studied also for the case of no delay costs.[9] By studying multi-period negotiations with both high and small costs of delay, we can test whether parties avoid deadline settlements only when such late conflict resolution causes rather drastic losses or whether small delay costs already suffice to induce early agreements.

In the literature shrinking pies are often ascribed to discounting: Negotiation takes time, consumption does not occur until agreement takes place, and future payoffs are discounted relative to present payoffs. Along these lines, we can assume that in our experiment bargainers discount any potential agreement according to some factor, which is kept constant over periods and is equal for the two parties. An economic example of this situation relates to wage negotiations over income streams. In a deterministic environment (where random events play no role), the reasons for reaching an early agreement could thus be the losses associated with delays, e.g., the income wasted by the employee and the employer during the dispute.[10] Institutionally, small costs of delay may also be induced by increasing negotiation costs, e.g. if each negotiation period causes costly travels, etc.

In addition to the bargaining horizon and the pie amount, procedural fairness of the bargaining game may affect the occurrence of late agreements.[11] Procedural fairness refers to the individuals' perception that a particular activity in

[9]An earlier experiment exploring how costs of delay and the number of possible periods influence bargaining behavior is reported in Ochs & Roth (1989). The authors, however, focused on the predictive accuracy of some qualitative predictions of the perfect equilibrium in sequential bargaining, without considering how the timing of agreements varies with the costs of delay.

[10]If the dispute involves a strike, the "joint-cost" theory of strikes (Kennan 1980, Reder & Neumann 1980) provides one possible answer to how and under which conditions part of the pie should be thrown away. On this issue see also Sopher (1990), who tests the joint-cost theory in shrinking-pie bargaining games with complete information.

[11]See Lind & Tyler (1988) for the notion (and evidence) of procedural fairness.

which they are involved is conducted fairly. We capture procedural fairness by distinguishing constant-proposer games and alternating-proposer games. In the former, proposer (and responder) roles are maintained throughout bargaining; in the latter, roles change after an offer has been rejected. Constant roles in case of no or small costs of delay definitely favor the constantly proposing party and are assumed to be not procedurally fair. Unfair procedures might trigger negative emotions, which in turn could delay or impede an agreement. Alternating roles like in Stahl (1972), Krelle (1991), and Rubinstein (1982) do not completely prevent procedural unfairness, but reduce it somewhat depending on the shrinking of the pie. When the pie decreases and roles alternate, the party who proposes in the current period needs to wait two periods until it is her turn again. If she is not likely to accept the intervening counteroffer, the damage is caused by two-period (instead of one-period) delay. We therefore expect alternating roles to yield more and earlier agreements, especially in case of decreasing pie.

Situations with constant roles typically apply when what can be exchanged has mainly to be designed by one party. In a trade agreement, for instance, the seller may be the only agent who is able to specify the product's details. In construction work, one will frequently find that the main offers are made by the supplier and that the buyer is often restricted to either accept or reject them. Alternating offer-bargaining, on the other hand, is the main practice when both sides have all the expertise to judge the adequacy of a contract offer. In collective wage bargaining this is more likely true in case of centralized negotiations (like in Scandinavia or Germany) where trade unions have their own research institutions.

Our findings reveal that alternating roles and small positive costs of delay attenuate late concessions in bargaining (i.e., help avoiding the deadline effect). However, only role alternation can be deemed as means of reducing the likelihood of conflicts.

In Section 2 we explain the experimental design and specify our behavioral expectations. In Section 3 we describe and analyze the results. We conclude in Section 4 by summarizing our main findings.

2 The experiment

2.1 Subjects

The computerized experiment was conducted at the Humboldt-University of Berlin using the software z-Tree (Fischbacher 1999). Participants, mainly students of business administration and economics, were all volunteers recruited by mail-shot invitations. Overall, we run 6 sessions: 3 employed the constant role treatment and 3 the alternating role treatment. Each session involved 12 participants who could be matched into 6 pairs. A session needed about two hours. The average earning per subject was €10.75, ranging from a minimum of €5 to a maximum of €14. The standard deviation of the individual earnings was €3.89.

2.2 Experimental procedures and behavioral predictions

Our experiment is based on a $2 \times 2 \times 2$-factorial design. The first factor refers to the pie dynamics (constant vs. decreasing pies), the second to the bargaining horizon (3 vs. 11 periods), and the third to the role assignment (constant vs. alternating roles). The first two factors are within-subjects, and the last factor is between-subjects. Thus, our participants bargain for constant *and* decreasing pies as well as over 3 *and* 11 periods with either constant or alternating roles.

Let p_t denote the monetary amount to be distributed in period t with $t =$

$1, \cdots, T$ where $T \in \{3, 11\}$ is the final period for reaching an agreement. If p_t is constant, we refer to the two games with $T = 3$ and $T = 11$ as C(3) and C(11), respectively. If p_t is decreasing, we refer to them as D(3) and D(11). This notation was used in the general part of the instructions, common to both treatments (see Appendix A).

Constant pie means $p_t = 100$ for $t = 1, 2, 3$ in C(3), and for $t = 1, \cdots, 11$ in C(11). With decreasing pies, p_t varies over time as follows:

- In D(3), one has $p_1 = 110$, $p_2 = 105$ and $p_3 = 100$;
- In D(11), one has $p_1 = 110$ and $p_t - p_{t+1} = 1$ for $t = 1, \cdots, 10$, so that $p_{11} = 100$.

Thus, deadline agreements in D(3) and D(11), i.e. accepted offers in the last period ($T = 3$ and $T = 11$, respectively), imply the same efficiency loss of 10 in total payoffs. This, of course, means that postponing an agreement by one period is much cheaper in D(11) than in D(3).[12]

In the constant role treatment (see Appendix A.1 for specific instructions), the two parties X and Y bargain in each period t by player X making an offer θ_t (with $0 \leq \theta_t \leq p_t$), which then Y can either accept or reject. If Y accepts the offer, an agreement is reached with X earning $p_t - \theta_t$ and Y earning the offered amount θ_t. If Y rejects the offer, and t is not the last period of the game (i.e., $t < T$), bargaining continues with period $t + 1$. If an offer made in the last period ($t = T$) is rejected by Y, then conflict results with 0-payoffs for both players.

In the alternating role treatment (see Appendix A.2 for specific instructions), player X makes a proposal in odd-numbered periods and player Y in even-numbered periods. The other party plays the role of the responder who either

[12] We did not perform experiments of games D(11) with delay costs of 5 or of games D(3) with delay costs of 1 in total payoffs since this would have overburden our design, and since deadline effects are very (un)likely in the second (first) case.

accepts or rejects the offer.[13]

The instructions informed participants about the four games C(3), C(11), D(3), and D(11) of multiple-period bargaining. First, participants were arbitrarily assigned to X- or Y-role and kept their role over the entire experiment.[14] After that they played C(3) twice, each time with a different partner. Then, in the same way, they played C(11), D(3), and D(11) where between games partners were randomly matched.[15] This cycle of $8 = 2 \times 4$ successive bargaining games was once repeated (see Figure 1). Thus, in total, a participant experienced each of the four games four times. When playing the same game again in the same cycle participants were sure to confront a new partner whereas re-meeting the same partner was possible between games.

Insert Figure 1 about here.

The game theoretical solution under the constant role mode can be easily computed. As payoffs are continuously divisible (in the sense that $0 \leq \theta_t \leq p_t$), in every period a self-interested proposer X should offer $\theta_t^* = 0$. When responder Y will accept such offer is less obvious. If Y expects X to behave optimally, (s)he will accept all positive offers, whereas in case of 0-offers now and in the future

[13]Let us illustrate the difference between constant and alternating proposers by an example. Consider game D(3) with $p_1 = 110$, $p_2 = 105$ and $p_3 = 100$, and assume a discrete payoff grid of 1 unit. In case of alternating roles, in equilibrium, player 1 would offer $\theta_3^* = 1$, player 2 $\theta_2^* = 100$, and therefore player 1 $\theta_1^* = 6$. In case of constant roles, player 1 would offer $\theta_3^* = 1$, $\theta_2^* = 2$, and $\theta_1^* = 3$.

[14]If roles were allowed to change throughout experimental treatments, X-players may propose high shares out of reciprocal motives, i.e. in order to receive high shares when they act as Y-players. Similarly, Y-players may accept rather meager proposals knowing that they can obtain higher payoffs when roles are reversed. To rule out this kind of reasoning and investigate (the same) proposers' and responders' behavior under different conditions, we decided to keep roles constant.

[15]A complete analysis of all $4! = 24$ possible orders of C(3), C(11), D(3), and D(11) would have been clearly impracticable. So we simply ordered games according to their complexity, by starting with the easiest one (namely the constant pie-short horizon game).

Y is indifferent between accepting or rejecting them.[16] Thus, in spite of multiple rounds, the predicted outcome with constant roles is similar to that in the usual ultimatum game.[17]

When the decreasing-pie games D(3) and D(11) are played with alternating roles, the continuous case implies the solution play: $\theta_1^* = 5$ and acceptance of X's initial offer by Y. The claim can be proved by backward induction. Consider D(3) with alternating roles. Since $\theta_3^* = 0$, Y has to offer at least 100 to X in period 2, i.e. $\theta_2^* = 100$, what leaves 5 for Y. Hence, X has to offer $\theta_1^* = 5$ to induce an early agreement.[18] In the same way one proves the claim in case of D(11).

Previous ultimatum experiments have, however, demonstrated that "buying" the responder acceptance is usually not inexpensive. Thus, behaviorally, we expect more balanced offers than those predicted by game theory. Especially, X should try to induce an early and efficient agreement (by a more generous offer θ_1) in the case of decreasing-pie games. When the pie shrinks it is, indeed, in the interest of the proposer (in case of constant roles) or of both proposer and responder (in case of alternating roles) to reach an early agreement. Consider, for instance, D(3) under the constant role mode. In the last period, $T = 3$, in equilibrium X would receive $p_3 - \theta_3^* = 100 - 0 = 100$. In period 2, by offering $\theta_2 = 1$, X could receive $p_2 - \theta_2 = 100 - 1 = 104$ if Y accepts. Of course, such considerations imply even higher earnings for X in period 1. Hence, we propose:

Prediction 1 *Initial proposals are higher in decreasing-pie games than in con-*

[16]A discrete payoff grid of one unit would imply equilibria at which Y refuses to take 0 but accepts the smallest positive offer (i.e., one unit).

[17]See, for instance, Güth, Schmittberger & Schwarze (1982).

[18]A smallest payoff grid of 1 unit and small (only in case of no indifference) trembles, would imply $\theta_3^* = 1$, $\theta_2^* = 100$ and $\theta_1^* = 6$, and acceptance of all these and better offers whereas all worse offers are rejected (all predictions are, of course, subject to strategy trembles).

stant-pie games.

This prediction can also be justified by thinking of the constant-pie game as the non-cooperative analogue of the free format set-up without experimentally induced delay costs. Earlier experimental evidence has shown that, in free format bargaining with no shrinkage of the pie, the deadline effect is quite robust (Roth et al. 1988, Sterbenz & Phillips 2001). Thus, although game theory cannot account for deadline effects even in constant-pie games (since one does not have to prove one's type by playing tough in sequential games of complete information), we expect constant pie games to induce a concentration of agreements in late periods, exactly as in former studies. Behaviorally, deadline effects are attributed to attempts to exploit a possible weakness of the others.[19] Our claim is that these attempts will be less important (compared to efficiency losses) when we introduce (small) costs of delay. That is, decreasing-pie games should lead to early concessions by the proposers.

Under the assumption of monotonic preferences, the probability of acceptance by the responders increases with the offered amount. Therefore, as a consequence of the early conceding, we test:

Prediction 2 *(Early) agreements are more frequent in decreasing-pie games than in constant-pie games.*

Although the asymmetry of roles sustains, alternating role-games appear procedurally fairer than constant role-games, since both parties (the X- and Y-participant) play both roles (the role of proposer and that of responder). In constant pie-games this is, in view of game theory, just a frame, since all what matters game theoretically is who is last in proposing. Nevertheless we expect

[19]According to Roth et al. (1988), this seems to dominate other behavioral concerns, like resolving strategic uncertainty as soon as possible or avoiding "haggling" over an agreement.

that alternating roles provoke stronger fairness considerations and more early conceding than constant roles, especially in decreasing pie-games but also to some degree in constant pie-games. Therefore, we test:

Prediction 3 *Alternating roles promotes more (early) agreements than constant roles whatever treatment we consider (3 vs. 11 periods and constant vs. decreasing pies).*

3 Results

This section reports on the statistical analysis of our main predictions, expecting (i) that initial proposals would be higher in decreasing- than in constant-pie games, (ii) that (early) agreements would be more frequently observed in decreasing- than in constant-pie games, and (iii) that alternating roles would generally promote more (early) agreements than constant roles.

Observation 1 *Initial offers (i.e., offers in period 1) by X to Y are higher in decreasing-pie games than in constant-pie games.*

Evidence for this observation is provided by the results of a repeated 2-way ANOVA with the two repeated factors pie characteristic (constant versus decreasing) and repetitions of each game type (1, ..., 4). The data for this analysis are obtained by averaging the individual offers made in period 1 across subjects and repetitions for each of the six experimental sessions, which represent six independent observations. Our results indicate that only the pie characteristic has a significant effect on initial offers ($F(1;5) = 9.434$, $p < .05$, $\eta^2 = .654$). On the contrary, we observe neither a significant effect for repetitions ($F(3;15) = 4.369$, $p = .129$, $\eta^2 = .814$) nor an interaction effect for pie characteristic and repetitions

($F(3;15) = 2.232$, $p = .263$, $\eta^2 = .691$). Bonferroni post-hoc tests reveal that, as predicted, initial offers are statistically significantly higher in decreasing-pie games than in constant-pie games ($M = 41.23$ vs. $M = 37.73$, $p < .05$). Table 1 displays the aggregate means of accepted offers as well as the means of final rejected offers for each experimental condition, i.e. constant vs. decreasing pie, constant vs. alternating role, and 3 vs. 11 bargaining periods.

Insert Table 1 about here.

Observation 2 *Over the long bargaining horizon, early agreements are more frequent in decreasing-pie games than in constant-pie games.*

This observation is supported by the results of a Wilcoxon signed ranks test comparing the cumulative distributions of acceptance rates for constant and decreasing pies. As indicated also by the cumulative distribution of agreements (see the top graph in Figure 2), when bargaining horizon extends over 11 periods, subjects conclude significantly more early agreements in decreasing-pie games than in constant-pie games ($z = 2.936$, $p < .01$). A qualitatively similar picture emerges for the short bargaining horizon (cf., bottom graph in Figure 2). Here, however, the cumulative distributions of acceptance rates are not statistically significantly different for decreasing- and constant-pie games ($z = 1.069, p = .285$). Besides illustrating these findings, Figure 2 shows that overall acceptance rates do not differ for constant and decreasing pies nor do they differ for the two bargaining horizons.

Insert Figure 2 about here.

It may be argued that with decreasing pies early agreements are more frequently observed in case of the short bargaining horizon, as in D(3) the pie shrinks at a faster rate than in D(11). A Wilcoxon signed ranks test comparing the cumulative distributions of acceptance rates in the two bargaining horizons for the decreasing pie does not confirm this conjecture: Agreement rates are not statistically significantly different in D(3) as compared to D(11) ($z = 1.604$, $p = .109$).

Observation 3 *Over the long bargaining horizon, early agreements are more frequent with alternating as compared to constant roles.*

Evidence for this observation comes from a Wilcoxon signed ranks test comparing the cumulative distributions of acceptance rates for constant and alternating roles, separately for constant and decreasing pies. In case of long bargaining horizon, subjects conclude significantly more early agreements when roles alternate than when they stay constant ($z = 2.943$, $p < .01$). This result holds both for the constant pie and for the decreasing pie. Although a qualitatively similar picture emerges for the short bargaining horizon (especially for the constant pie), the cumulative distributions of acceptance rates are not statistically significantly different for alternating as compared to constant roles ($z = 1.604$, $p = .109$). Again, no difference is observable with respect to constant and decreasing pies. The cumulative distributions of acceptance rates for the long bargaining horizon are depicted in Figure 3, separately for the constant pie (top graph) and the decreasing pie (bottom graph). The analogous cumulative distributions for the short bargaining horizon are illustrated in Figure 4.

Insert Figures 3 and 4 about here.

Generally we observe concessions in the last round (and, hence, deadline effects) in all experimental conditions. However, they are less frequent in case of decreasing pies and alternating roles. To test for concession making, we compare the offers by X-participants in round T with their earlier offers. Conceding means that later offers exceed the earlier ones. Denote by $\underline{\theta}_T$ the mean offers in the final period and by $\underline{\theta}^X_{t<T}$ the mean earlier rejected offers by the same X-participants.[20] Table 2 lists these two variables and reports their difference for each of the four repetitions of the 8 game types of the experiment.

<u>Insert Table 2 about here.</u>

The general tendency is that $\underline{\theta}_T$ exceeds $\underline{\theta}^X_{t<T}$. Nevertheless, while in the constant role-treatment (except for the first 2 repetitions of C(3)) the difference between $\underline{\theta}_T$ and $\underline{\theta}^X_{t<T}$ is larger than 5%, this does not generally apply to the alternating role-treatment, especially with decreasing pies. From Table 2 one can see that, when participants bargain over a decreasing pie and alternate their role, the mean offers in the last period are either smaller than the mean offers in the previous periods or about 1% higher. Wilcoxon signed ranks tests conducted for each repetition of all 8 games with individual data as observations reveal that the difference between $\underline{\theta}_T$ and $\underline{\theta}^X_{t<T}$ is significant ($p < .05$):

(i) for each of the 4 repetitions of C(11) and D(11) under the constant role-treatment,

(ii) for the last three repetitions of C(3) in the constant role-treatment, and of C(11) in the alternating role-treatment,

(iii) for the third repetition of C(3) in the alternate role-treatment, and

(iv) for the second repetition of D(3) in the constant role-treatment.

[20] One may object that this does not control for last offers θ_T which are still too low to be acceptable. Even when one restricts attention to accepted last offers, late conceding can be validated, i.e. the average accepted offers exceed the mean earlier offers by the same X-participants.

Thus, in case of decreasing pies and alternating roles, offers in the last period are not significantly different from offers in the t ($< T$) previous periods. In addition, the probability that offers are accepted increases from the earlier periods to the final period: According to Table 2, the probability $p(\underline{\theta}_T)$ that an offer is accepted in the final period exceeds the acceptance probability $p(\underline{\theta}^X_{t<T})$ of the previously submitted offers. This finding indicates that participants increased their offers in the final period strategically, thereby engaging in late concessions.

While deadline effects, as indicated by concessions in the last round, are observable in all experimental conditions, we still need to establish whether conflicts (in the sense of failing to reach a final agreement) can be reduced by introducing small delay costs or by increasing "procedural fairness" (here captured by alternating roles). Our results suggest that only the introduction of role alternation is effective in reducing the number of conflicts in final bargaining rounds ($\chi^2_{(1)} = 11.213$, $p < .01$). Decreasing pies, on the other hand, do not lead to a reduced number of conflicts ($\chi^2_{(1)} = 0.053$, $p = .819$).[21]

4 Conclusions

In this paper we reported on an experiment designed to explore the robustness of the "deadline effect" in multiple-period structured bargaining games. Particularly, we concentrated on three issues that may account for delaying agreements and the occurrence of conflicts: the length of the bargaining horizon (3 vs. 11 negotiation periods), the characteristic of the pie (constant vs. decreasing pie), and whether or not parties' roles alternate over the course of bargaining.

In free format bargaining environments with neither shrinkage of the pie nor

[21]The exact χ^2-values, however, should be considered with great caution since the assumption of independence is not met.

explicitly modelled random delays in the transmission of proposals, it has been frequently observed that there are a large number of agreements in the last seconds near the deadline. The experimental results by Sterbenz & Phillips (2001), on the other hand, indicate that if proposals are explicitly delayed, agreements are more uniformly spread across a bargaining period, although the percentage of defaults is not significantly different from the case of no explicit delays.

Our main findings reveal that, in a structured bargaining set-up (where proposals have no chance to be delayed), if the bargaining horizon is sufficiently long, shrinking the pie or alternating parties' roles triggers higher initial proposals and more early agreements than the design with constant pie or constant roles.

Although Sterbenz & Phillips (2001) use a different approach to deadlines, their analysis can be somehow contrasted with ours. They show that anticipated random delays eliminate the flurry of activity at the end of the period. We show that, even with no chance of delays, the deadline effect is less frequent if the pie shrinks and roles alternate, especially for the long bargaining horizon. Furthermore, Sterbenz & Phillips (2001) show that the experiments with random delays and without delays do not differ in the numbers of conflicts. Likewise, we find that introducing small delay costs has no impact on the numbers of conflicts whereas role alternation appears to be an appropriate means to reduce defaults.

The fact that our main findings are restricted to long horizon games illustrates the importance to supplement the usual short horizon perspective exhibited in many previous studies (e.g., Ochs & Roth 1989, and Anderhub, Güth & Marchand forthcoming) by a much longer planning horizon. Institutionally, this captures situations where parties can meet often (because, for instance, they are located rather closely or visit the same exhibition, fair), and where both sides have enough expertise to specify offers.

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Appendix A: General instructions

In this experiment, two participants at a time will interact with each other over a sequence of rounds. Thereby, each participant will be confronted with different situations in which (s)he is negotiating with changing partners. The negotiations will extend over 3 or 11 negotiating rounds, and the amount to be distributed between participants is constant in case of situation C(t) and diminishing in case of situation D(t).

In case of situation D(t), the amounts that can be distributed are:

- 110 in the first round, 105 in the second round and 100 in the third round if $t = 3$;
- 110 in the first round, the amount of the previous round minus 1 in each of the subsequent rounds if $t = 11$.

The four different situations are thus:

C(3): In negotiations of at most three rounds, partners can distribute a constant amount of 100.

C(11): In negotiations of at most eleven rounds, partners can distribute a constant amount of 100.

D(3): In negotiations of at most three rounds, partners can distribute 110 in the first round, 105 in the second round, and 100 in the third round.

D(11): In negotiations of at most eleven rounds, partners can distribute 110, 109, 108, 107, 106, 105, 104, 103, 102, 101, 100 in the 1st, 2nd, 3rd, 4th, 5th, 6th, 7th, 8th 9th, 10th, 11th round, respectively.

It remains to explain how the two partners can negotiate about the distribution of the amount in each round.

Appendix A.1: Specific instructions for constant roles

How can the two partners negotiate about the distribution of the amount B_t in round t?

In each round, participant P (P stands for proposer) proposes to the other participant R (because R responds) a part A of B_t with $0 \leq A \leq B_t$. This means that P claims the residual amount $B_t - A$ for him/herself.

- If R accepts the proposal, they have agreed: R obtains A and P obtains $B_t - A$.
- If R rejects the proposal, the next round starts in which the amount B_{t+1} must be distributed.
- If R rejects the proposal and it is the last round, both R and P obtain 0.

In the experiment, the roles P and R are assigned randomly. Your role will be told you at the beginning of the experiment and you will keep it throughout.

You will start with situation C(3) which you will experience twice, each time with a different partner. In the same way, you will then confront situations C(11), D(3) and D(11) in that order, where your partner will randomly change after each round.

This cycle of $8 = 2 \times 4$ rounds will be once repeated, i.e. you will once again interact in C(3), C(11), D(3) and D(11) with a different partner in each different round.

Appendix A.2: Specific instructions for alternating roles

How can the two partners negotiate about the distribution of the amount B_t in round t?

In odd rounds (i.e. $t = 1, 3$ in case of C(3) and D(3), and $t = 1, 3, 5, 7, 9, 11$ in case of C(11) and D(11)), participant O (O stands for odd) proposes to the other participant E (E for even) a part A of B_t with $0 \leq A \leq B_t$. This means that O claims the residual amount $B_t - A$ for him/herself.

In even rounds (i.e. $t = 2$ in case of C(3) and D(3), and $t = 2, 4, 6, 8, 10$ in case of C(11) and D(11)), the roles are reversed: Participant E proposes to O a part A of B_t with $0 \leq A \leq B_t$ and claims the residual amount $B_t - A$ for him/herself.

- If E accepts the proposal A of O in case of odd rounds, or O accepts the proposal A of E in case of even rounds, they have agreed: the accepting responder obtains A and the proposer obtains $B_t - A$.
- If the proposal A is rejected, the next round starts in which the amount B_{t+1} must be distributed between the two partners with reversed roles.
- If the proposal A is rejected and it is the last round, both O and E obtain 0.

In the experiment, the roles O and E are assigned randomly. Your role will be told you at the beginning of the experiment and you will keep it throughout.

You will start with situation C(3) which you will experience twice, each time with a different partner. In the same way, you will then confront situations C(11), D(3) and D(11) in that order, where your partner will randomly change after each round.

This cycle of $8 = 2 \times 4$ rounds will be once repeated, i.e. you will once again interact in C(3), C(11), D(3) and D(11) with a different partner in each different round.

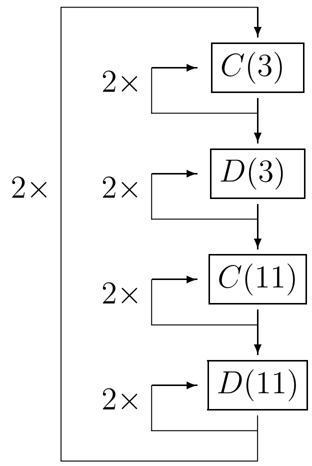


Figure 1: Sequence of events in the experiment

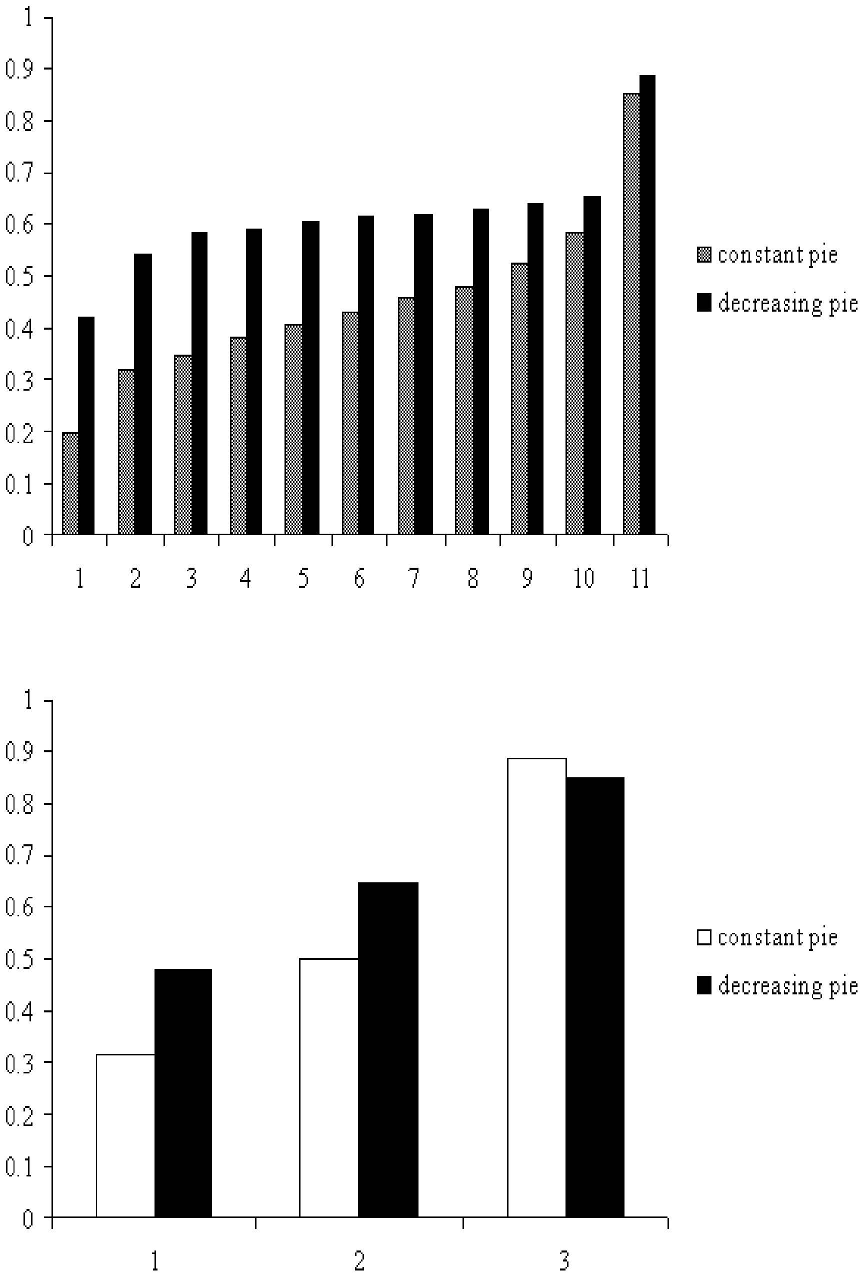
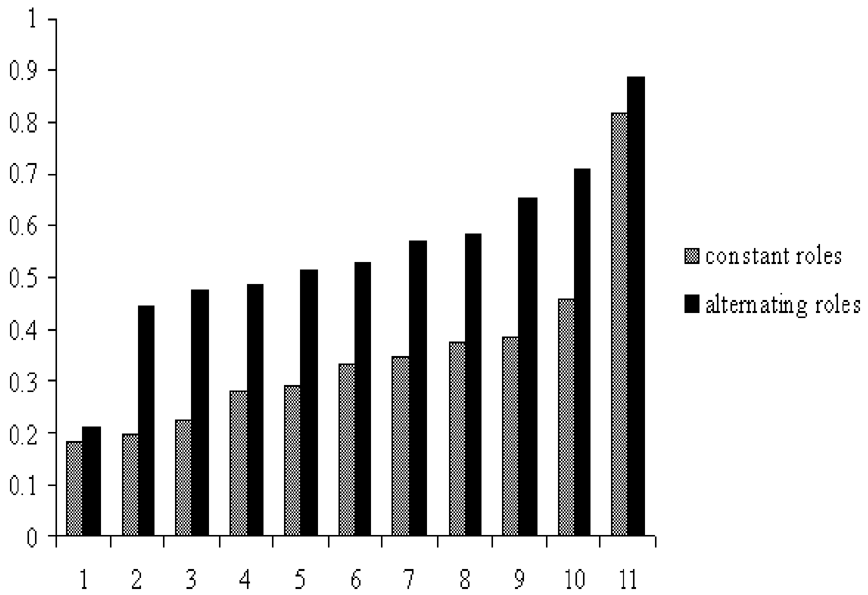


Figure 2: Cumulative distribution of acceptance rates with respect to constant and decreasing pies for both bargaining horizons

Constant Pie



Decreasing Pie

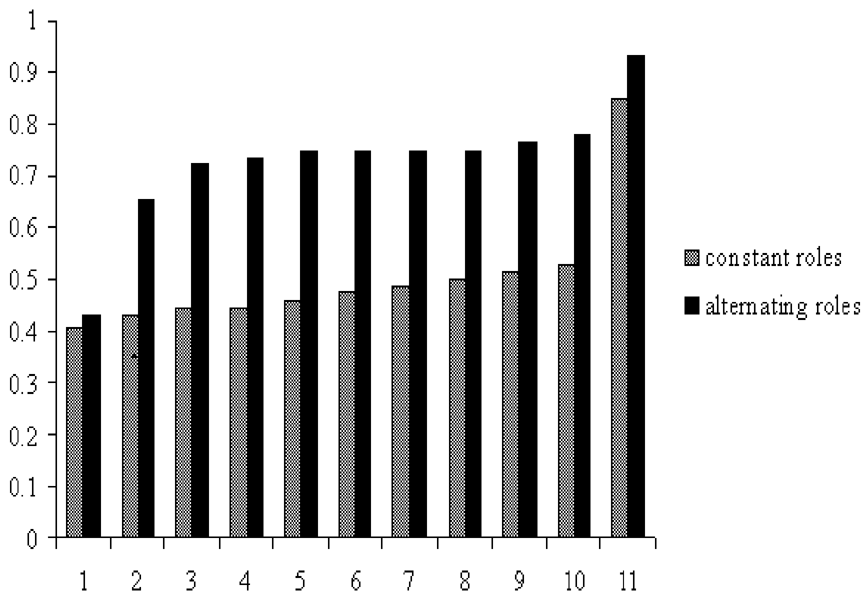
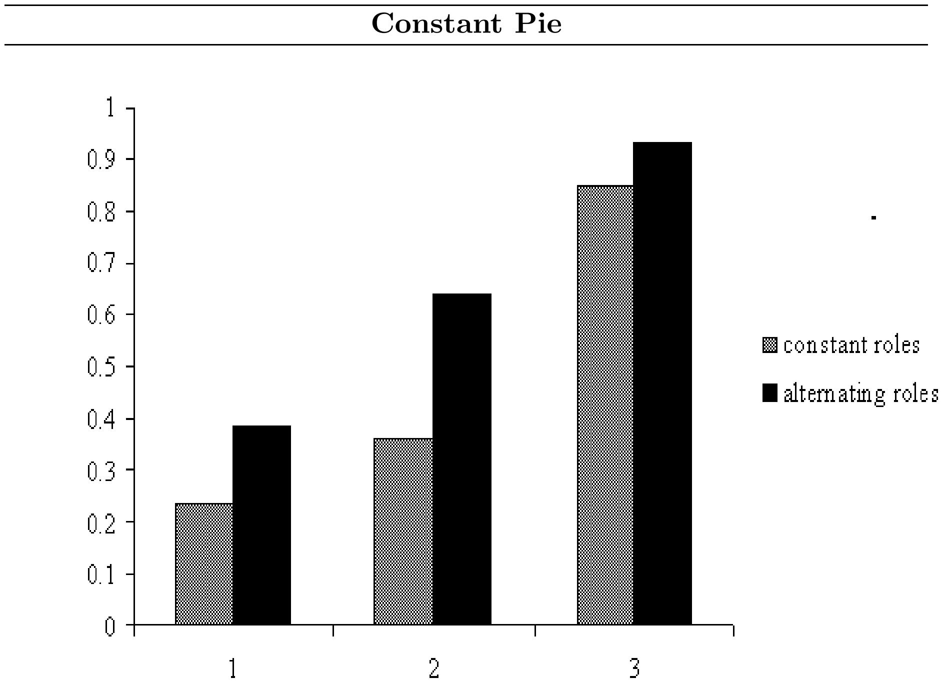


Figure 3: Cumulative distribution of acceptance rates with respect to constant and alternating roles for both (constant and decreasing) pies, in case of the long bargaining horizon



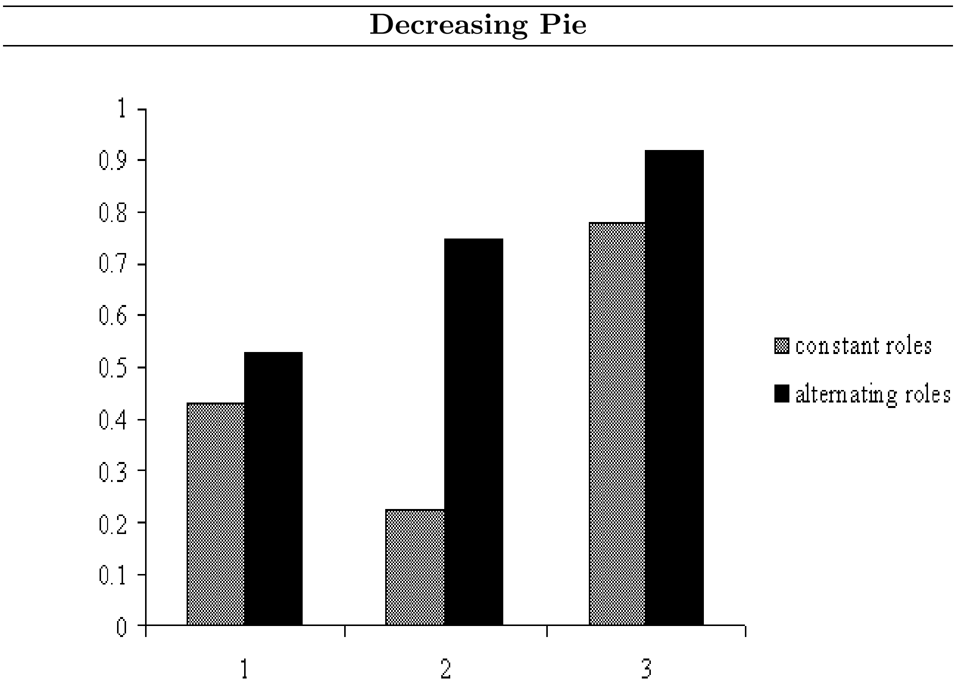


Figure 4: Cumulative distribution of acceptance rates with respect to constant and alternating roles for both (constant and decreasing) pies, in case of the short bargaining horizon

Table 1: Frequency of agreements, mean of accepted offers, and mean of final rejected offers for each of the four repetitions of the games (columns I to IV) with respect to constant and decreasing pies, constant and alternating roles, and short and long time horizons.

Constant Pie

			I				II				III				IV			
Roles	*Horizon*		*f*	*M*	*SD*	*MD*	*f*	*M*	*SD*	*MD*	*f*	*M*	*SD*	*MD*	*f*	*M*	*SD*	*MD*
Altern.	3	*a*	17	50.6	13.6	50.0	17	46.5	6.9	49.0	16	47.7	44.5	44.6	17	47.1	4.8	48.0
		c	1	33.0			1	20.0			2	40.0	2.8	40.0	1	41.0		
	11	*a*	14	49.4	2.6	50.0	16	46.6	5.9	50.0	16	45.5	10.6	48.5	18	47.3	4.4	49.0
		c	4	31.2	12.2	32.0	2	40.0			2	37.5	5.0	37.5	0			
Const.	3	*a*	15	44.7	6.3	45.0	15	40.8	8.4	42.0	16	43.6	6.2	42.5	14	45.4	4.6	45.0
		c	3	18.7	17.0	20.0	3	23.0	23.6	20.0	2	35.0	7.1	35.0	4	32.5	11.9	37.5
	11	*a*	14	42.5	8.4	44.0	15	42.7	10.3	40.0	15	43.5	6.3	44.0	14	46.0	4.7	46.0
		c	3	26.5	17.8	31.5	3	31.7	7.6	30.0	3	36.0	6.9	40.0	3	33.8	6.9	34.5

Decreasing Pie

			I				II				III				IV			
Roles	*Horizon*		*f*	*M*	*SD*	*MD*	*f*	*M*	*SD*	*MD*	*f*	*M*	*SD*	*MD*	*f*	*M*	*SD*	*MD*
Altern.	3	*a*	17	46.8	3.3	45.5	16	46.5	4.9	46.2	17	45.0	9.7	47.7	16	46.4	3.8	47.5
		c	1	35.0			2	39.5	1.0	39.0	1	45.0			2	45.0		45.0
	11	*a*	15	47.9	2.8	49.5	17	47.3	2.7	47.3	17	47.8	5.2	48.1	18	48.7	3.4	49.5
		c	3	40.0	5.0	40.0	1	42.0			1	44.0			0			
Const.	3	*a*	11	46.2	6.3	48.6	14	45.3	5.5	45.5	16	44.9	5.5	45.7	15	44.7	5.0	45.5
		c	6	34.3	5.8	32.5	4	32.5	7.1	31.5	3	40.0			3	34.3	5.1	33.0
	11	*a*	14	44.5	7.2	46.8	15	43.8	6.6	42.7	15	44.8	5.3	45.5	16	45.2	5.1	45.7
		c	4	34.8	6.9	37.0	3	36.7	4.7	35.0	3	36.3	10.0	40.0	2	37.5	3.5	37.5

Note: *a* denotes aggregated accepted offers across all periods (either 3 or 11).
c denotes average final offers that got not accepted.

Table 2: Mean offers in the last period, T, and in all $T-1$ previous periods for constant and decreasing pies, short and long bargaining horizons, and constant and alternating roles.

Game		Constant roles				Alternating roles			
		I	II	III	IV	I	II	III	IV
C(3)	$\underline{\theta}_T$	32.88	34.18	40.87	40.15	34.00	39.13	44.89	42.00
	$p(\underline{\theta}_T)$	0.00	1.00	0.75	0.75	1.00	1.00	0.87	1.00
	$\underline{\theta}^X_{t<T}$	29.50	29.77	34.33	34.62	20.00	36.57	41.67	39.13
	$p(\underline{\theta}^X_{t<T})$	0.00	0.00	0.00	0.00	0.00	0.02	0.25	0.02
	$\underline{\theta}_T - \underline{\theta}^X_{t<T}$	3.38	4.41	6.53	5.54	14.00	2.56	3.22	2.88
C(11)	$\underline{\theta}_T$	33.44	37.00	38.36	38.70	33.18	41.60	42.50	45.00
	$p(\underline{\theta}_T)$	0.38	0.00	0.67	0.67	0.38	0.71	0.50	0.87
	$\underline{\theta}^X_{t<T}$	25.50	29.10	32.64	33.49	30.48	35.96	38.12	32.52
	$p(\underline{\theta}^X_{t<T})$	0.03	0.00	0.12	0.11	0.07	0.02	0.07	0.12
	$\underline{\theta}_T - \underline{\theta}^X_{t<T}$	7.94	7.90	5.73	5.21	2.70	5.64	4.38	12.48
D(3)	$\underline{\theta}_T$	36.20	35.63	39.71	38.50	40.50	40.75	43.33	43.00
	$p(\underline{\theta}_T)$	1.00	0.60	1.00	0.67	0.74	0.74	0.67	0.67
	$\underline{\theta}^X_{t<T}$	31.58	28.68	34.19	29.02	38.64	41.45	44.24	43.86
	$p(\underline{\theta}^X_{t<T})$	0.32	0.00	0.00	0.00	0.07	0.25	0.21	0.11
	$\underline{\theta}_T - \underline{\theta}^X_{t<T}$	4.62	6.95	5.52	9.48	1.86	-0.70	-0.91	-0.86
D(11)	$\underline{\theta}_T$	36.33	37.50	39.11	40.38	42.00	44.20	42.25	43.50
	$p(\underline{\theta}_T)$	1.00	0.00	1.00	0.74	0.50	0.87	1.00	0.67
	$\underline{\theta}^X_{t<T}$	30.51	31.69	28.34	26.01	37.98	41.43	41.38	43.19
	$p(\underline{\theta}^X_{t<T})$	0.07	0.00	0.00	0.00	0.07	0.25	0.25	0.11
	$\underline{\theta}_T - \underline{\theta}^X_{t<T}$	5.82	5.81	10.77	14.36	4.02	2.77	0.87	0.31

Note: $p(\underline{\theta}_T)$ denotes the probability that an offer θ_T is accepted based on the probability distribution of all final offers, whereas $p(\underline{\theta}^X_{t<T})$ denotes the probability of acceptance based on the probability distribution of all previous offers.