Online Appendix A, B, C — Beyond Dividing the Pie: Multi-Issue Bargaining in the Laboratory

Olivier Bochet Manshu Khanna Simon Siegenthaler

Appendix A provides supplementary analysis for the main treatments with unstructured bargaining. Appendix B provides supplementary analysis for the treatments with ultimatum bargaining. Appendix C provides supplementary analysis for the treatments with noisy information.

A Unstructured Bargaining

Table 1 provides regressions of the demanded share of total surplus depending on the total surplus interacted with the bundle sizes. In contrast to the main text, here we provide the results focusing on accepted offers only. Models (1), (4) and (7) do not include a constant, thus the coefficients can be interpreted as the average realized share of total surplus. Models (2), (5) and (8) include a constant. Models (3), (6) and (9) include additional controls. Table 1 shows that the realized share of total surplus is not larger for bundles than for single-items in the *No Info* and *Intermediate Info* treatments.

Figure 1 shows the distribution of the proportion of alternating offers A across offer sequences. The histograms show that alternating-offers bargaining is the most important mode of interaction in all information treatments, and for both single-item and bundle offer sequences.

Figure 2 shows the distribution of Σ to highlight split-the-difference bargaining patterns. The histograms show that:

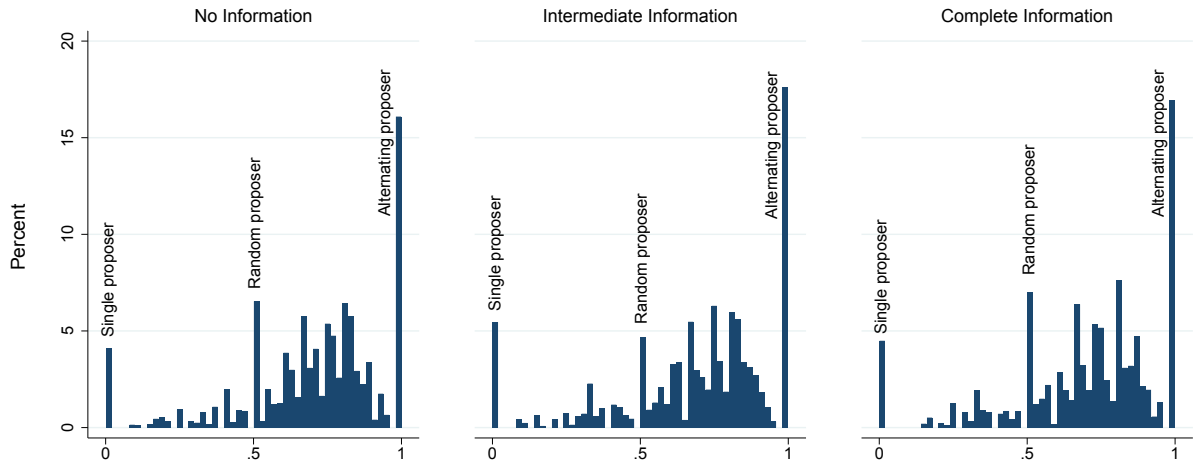
(i) There are no significant treatment differences (see 2a);

(ii) The patterns are observed for both single-item and bundle offer sequences (see 2b);

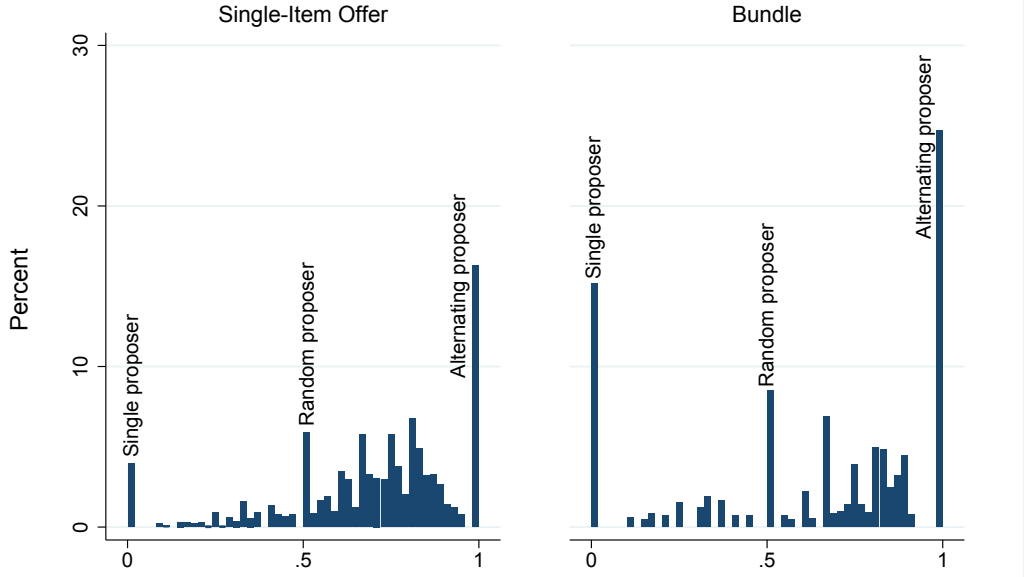
(iii) Split-the-difference offers are common for early offers in a sequence (see 2c).

Next, we extend the analysis of variable Σ to offer sequences that are not fully alternating. We do so by removing from the non-fully alternating offer sequences the non-alternating offers. Specifically, in an offer sequence, for each set of consecutive offers made by a player, we keep the last offer and remove the others. Suppose Ann makes the 1st, 2nd, 5th and 6th offer in an offer sequence while Bob makes the 3rd, 4th offer. Then, Ann's 2nd and 6th offer and Bob's 4th offer will be part of the sequence we used for subsequent analysis. Generating these offer sequences allows us to define Σ for offer sequences that are not fully alternating and thus provides a robustness check for the split-the-difference bargaining patterns presented for the fully alternating sequences. Figure 3 shows that including offer sequences that are not fully alternating does not change the results qualitatively. Most offers that do not insist on the previously proposed price meet the price proposed by the other party halfway to achieve a split-the-difference deal.

Figure 1: Histograms for Alternating Proposers



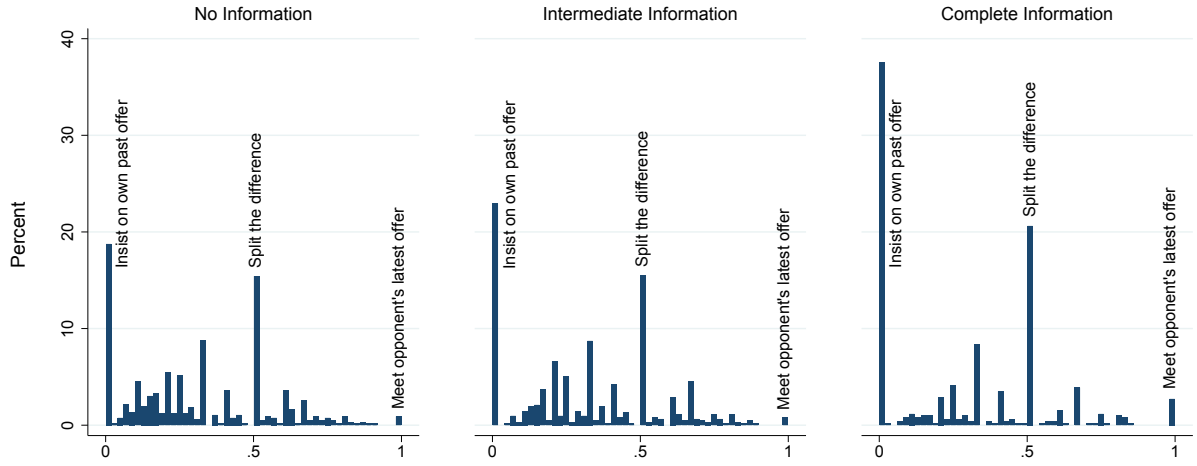
(a) Information



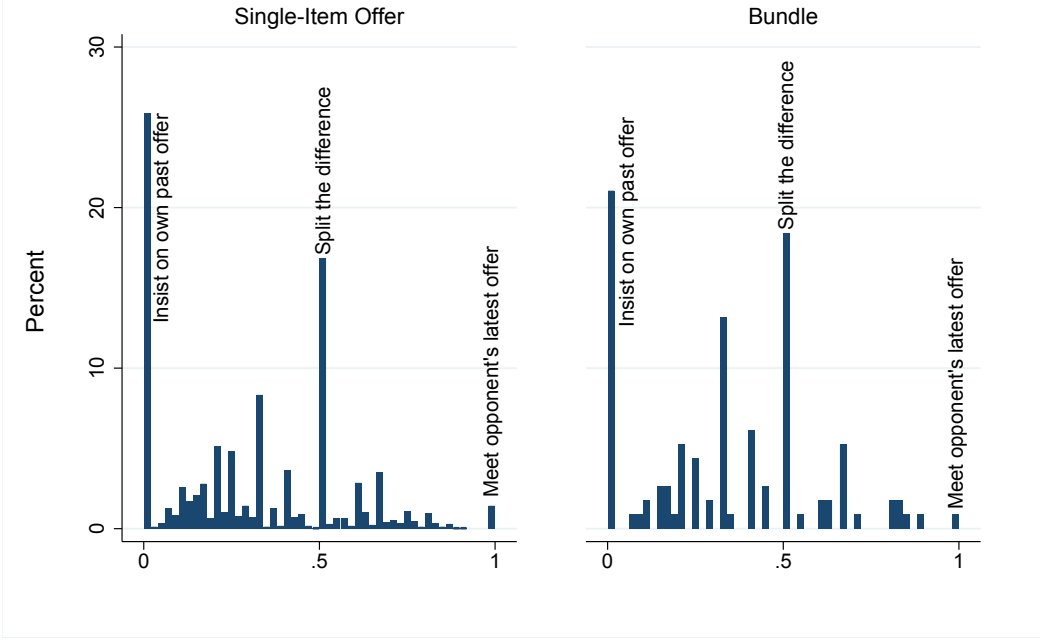
(b) Bundling

Notes: Figures show histograms for the proportion of alternating offers in a negotiation (A).

Figure 2: Histograms for Split-the-Difference

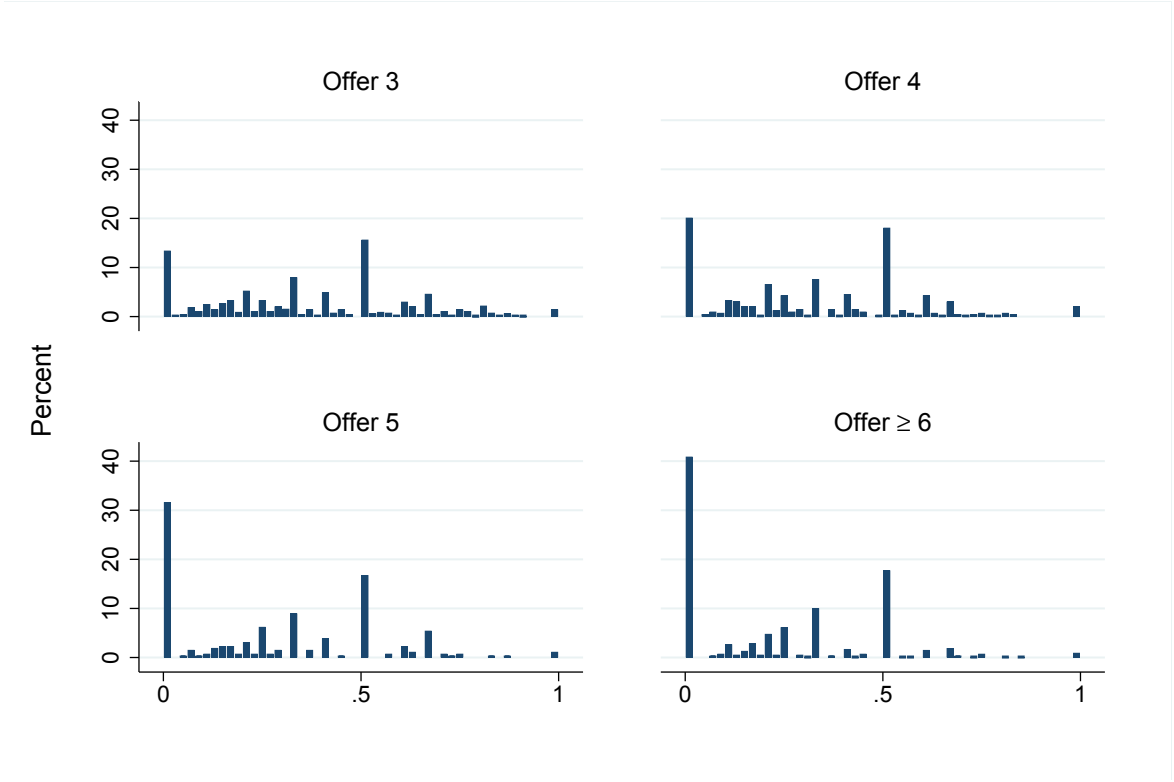


(a) Information



(b) Bundling

Figure 2: Histograms for Split-the-Difference



(c) By Offer Number

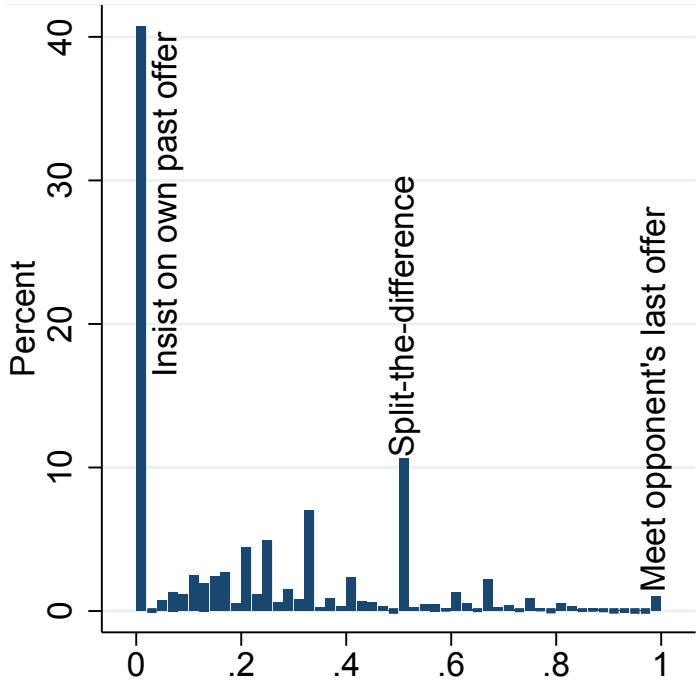
Notes: Figures shows a histogram of the split-the-difference measure (Σ).

Table 1: Realized Share of Total Surplus

	No Information			*Intermediate Information*			*Complete Information*		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Total Surplus (TS)	0.440***	0.415***	0.345***	0.391***	0.342***	0.322***	0.336***	0.300***	0.292***
	(0.0217)	(0.0377)	(0.0451)	(0.0395)	(0.0571)	(0.0583)	(0.0237)	(0.0307)	(0.0281)
Two-Item Bundle ∗ TS	-0.0129	-0.00212	0.0159	0.0361	0.0487	0.0589	0.117***	0.125***	0.123***
	(0.0319)	(0.0275)	(0.0243)	(0.0393)	(0.0419)	(0.0421)	(0.0362)	(0.0337)	(0.0342)
Three-Item Bundle ∗ TS	-0.129	-0.110	-0.0951	0.115	0.131	0.149	0.0505	0.0649*	0.0634*
	(0.0954)	(0.0784)	(0.0778)	(0.103)	(0.105)	(0.103)	(0.0414)	(0.0337)	(0.0330)
Item-by-Item ∗ TS	0.0455	0.0499*	0.0546**	0.0495	0.0564	0.0561	0.0504*	0.0599**	0.0636**
	(0.0284)	(0.0278)	(0.0242)	(0.0478)	(0.0471)	(0.0478)	(0.0271)	(0.0278)	(0.0251)
Proposal Time (sec.)			-0.0176***			-0.0106***			0.00662***
			(0.00425)			(0.00226)			(0.00250)
Risk Tolerance			-0.141			0.162			-0.00425
			(0.276)			(0.203)			(0.157)
Selfishness			0.301			1.154**			-0.506
			(0.567)			(0.487)			(0.412)
Constant		0.508	3.923**		0.890*	0.680		0.659**	0.114
		(0.538)	(1.624)		(0.457)	(1.150)		(0.307)	(0.748)
Offers (N)	377	377	377	407	407	407	460	460	460
Matching Groups	17	17	17	17	17	17	17	17	17

Notes: * significant at 10%, ** significant at 5%, *** significant at 1%. OLS regressions for *No Info*, *Int. Info*, *Complete Info* with standard errors clustered on matching group level. Models (3), (6), (9) include period dummies.

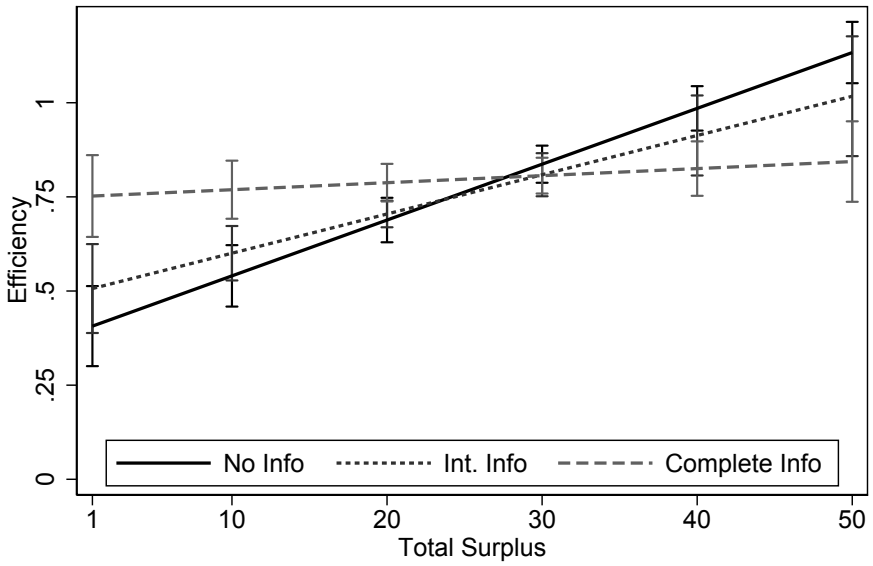
Figure 3: Histogram for Split-the-Difference Including Non-Fully-Alternating Offer Sequences



B Ultimatum Bargaining

Figure 4 shows that, as in the main treatments, improved information facilitates trade of small-surplus items and thus raises efficiency, but improved information plays the opposite role for large-surplus items. Table 2 shows that fairness preferences are among the main hurdles that prevent agreement under complete information, as the selfish dummy has a significant and negative effect on the probability of agreement.

Figure 4: Multi-Issue Ultimatum Bargaining: Efficiency



Notes: Efficiency is calculated as the sum of realized surplus divided by the sum of maximum surplus in a matching group and then averaged for each treatment. Predicted probabilities with 95% confidence intervals are from linear random effects regressions with dependent variable efficiency on the negotiation-level (realized surplus divided by maximum surplus available in a given negotiation) and standard errors clustered on matching groups.

Table 2: Ultimatum Bargaining: Regressions—Probability of Agreement and Efficiency

	Agreement
Int. Info	0.358
	(0.246)
Complete Info	0.715***
	(0.211)
Surplus	0.0486***
	(0.00508)
Int. Info ∗ S	-0.0172**
	(0.00775)
Complete Info ∗ S	-0.0469***
	(0.00761)
Selfishness	0.230***
	(0.0709)
Int. Info ∗ Selfishness	-0.378**
	(0.164)
Complete Info ∗ Selfishness	-0.424***
	(0.102)
Risk Tolerance	-0.0226
	(0.0348)
Int. Info ∗ Risk Tolerance	0.0255
	(0.0473)
Complete Info ∗ Risk Tolerance	0.0679
	(0.0447)
Period	-0.00389
	(0.0100)
Constant	0.540***
	(0.170)
Items	832
Matching Groups	24

Notes: * significant at 10%, ** significant at 5%, *** significant at 1%. Standard errors in parentheses. Random effects for probability of agreement (linear) with standard errors clustered on matching group level. Reference group: *No Info*. The variable Surplus corresponds to the surplus of an item. Risk Tolerance is taken from the proposer in a negotiation. Selfishness is a dummy variable that indicates if at least one of the bargainers in a pair is classified as selfish.

C Unstructured Bargaining with Noisy Information

Figure 5 shows that noisy information leads to a reduction in efficiency for small-surplus items in *Complete Info* compared to the main treatments, thus making the efficiency gains from information disappear for small-surplus items as well.

In the main text we presented results regarding the negotiation process for our main treatments. Now we show that the results replicate well in the treatments with noisy information.

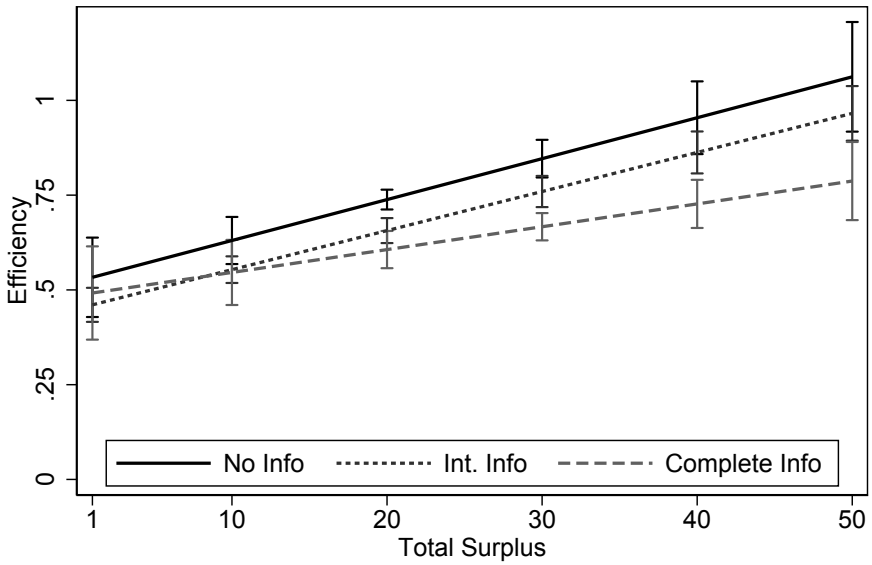
(i) Figure 6 shows the number of offers made is almost double in *No Info* than in *Complete Info*, with *Int. Info* lying between the two. The timing of offer acceptances is the same across treatments.

(ii) Table 3 shows that bundled offers are significantly more aggressive than offers on individual items.

(iii) Figure 7 most negotiations are characterized by alternating offers bargaining, with frequent split-the-difference offers.

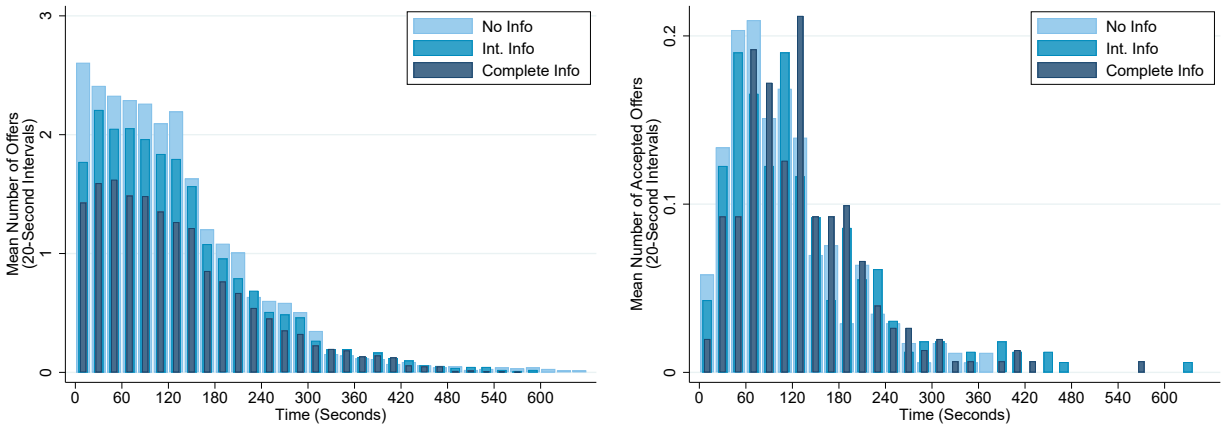
(iv) Figure 8 shows that offer sequences with a larger percentage of alternating offers are substantially more likely to result in agreement, and split-the-difference offers are particularly likely to be accepted.

Figure 5: Noisy Information: Efficiency



Notes: Efficiency is calculated as the sum of realized surplus divided by the sum of maximum surplus in a matching group and then averaged for each treatment. Predicted probabilities with 95% confidence intervals are from linear random effects regressions with dependent variable efficiency on the negotiation-level (realized surplus divided by maximum surplus available in a given negotiation) and standard errors clustered on matching groups.

Figure 6: Noisy Information: Timing of Proposed and Accepted Offers

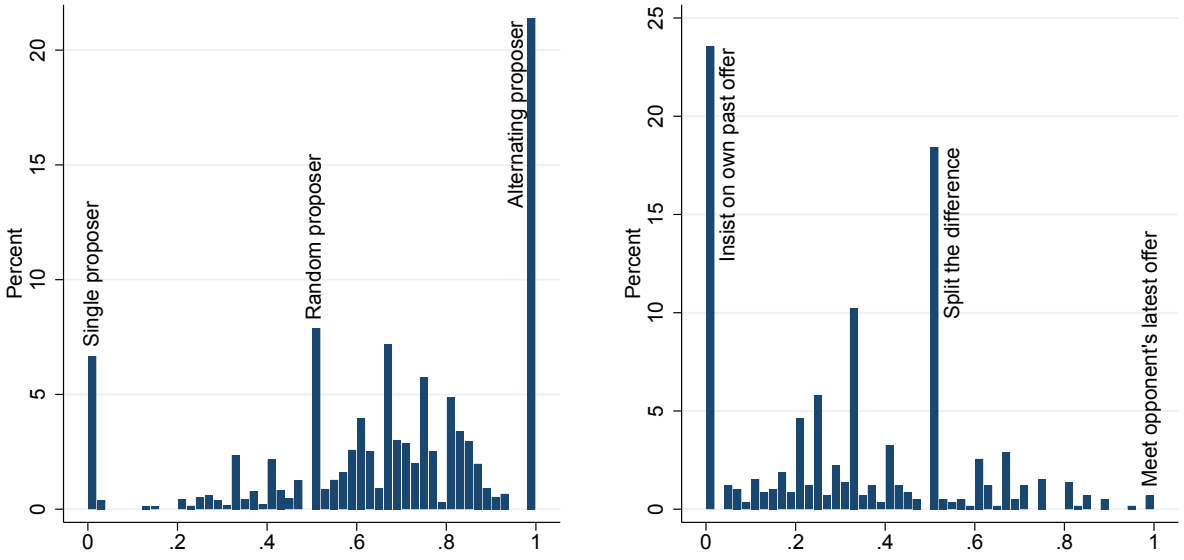


(a) Offers over Time

(b) Acceptances over Time

Notes: Figure ***(a)*** shows the mean number of proposed offers (single-item and bundles) per 20-second interval averaged by information structure. Figure ***(b)*** shows the mean number of accepted offers.

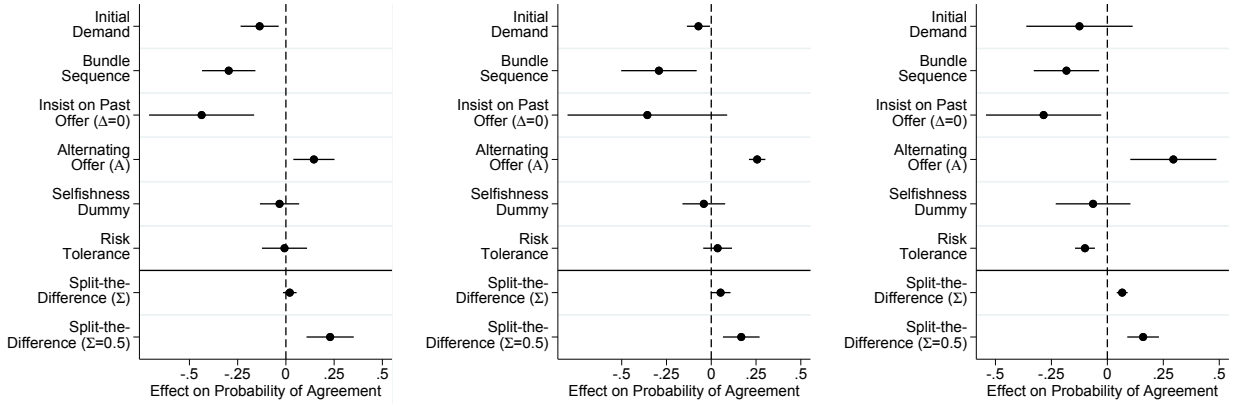
Figure 7: Noisy Information: Alternating Proposers and Split-the-Difference



(a) Alternating Offers (A) (b) Split-the-Difference (Σ)

Notes: Figure ***(a)*** shows a histogram for the percentage of alternating offers in a negotiation (A). Figure ***(b)*** shows a histogram of the split-the-difference measure (Σ).

Figure 8: Noisy Information: Negotiation Process and Agreement Probability



(a) No Information (b) Intermediate Information (c) Complete Information

Notes: Marginal effects and 95% confidence intervals (cluster-robust standard errors) from linear random effects models on the probability of agreement of different bargaining process variables. The unit of observation is an offer sequence for the coefficients above the horizontal line and a single offer for coefficients below the horizontal line.

Table 3: Demanded Share of Total Surplus

	No Information			*Intermediate Information*			*Complete Information*		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Total Surplus (TS)	0.545***	0.107**	0.0749	0.547***	0.243***	0.205***	0.430***	0.276***	0.277***
	(0.0163)	(0.0479)	(0.0461)	(0.0246)	(0.0435)	(0.0297)	(0.0465)	(0.0510)	(0.0413)
Two-Item Bundle $*$ TS	0.118***	0.246***	0.231***	0.0739***	0.148***	0.159***	0.0803	0.126***	0.134***
	(0.0221)	(0.0340)	(0.0273)	(0.0154)	(0.0235)	(0.0221)	(0.0418)	(0.0390)	(0.0388)
Three-Item Bundle $*$ TS	0.497***	0.653***	0.579***	0.255***	0.394***	0.385***	0.248**	0.301***	0.290***
	(0.0692)	(0.0525)	(0.0558)	(0.0338)	(0.0436)	(0.0469)	(0.0829)	(0.0683)	(0.0554)
Proposal Time (sec.)			-0.0255***			-0.0163***			-0.0129***
			(0.00314)			(0.00457)			(0.00171)
Risk Tolerance			-0.0522			-0.0553			-0.0935
			(0.246)			(0.312)			(0.248)
Selfishness			-0.657			1.704*			0.451
			(1.090)			(0.940)			(0.651)
Constant		6.458***	9.506***		4.887***	6.159***		3.022***	5.610***
		(0.722)	(1.017)		(0.536)	(1.277)		(0.470)	(1.186)
Offers (N)	3063	3063	3063	2536	2536	2536	2039	2039	2039
Matching Groups	6	6	6	6	6	6	6	6	17

Notes: * significant at 10%, ** significant at 5%, *** significant at 1%. OLS regressions for *No Info*, *Int. Info*, *Complete Info* with standard errors clustered on matching group level. Models (3), (6), (9) include period dummies.