Homo Æqualis: A Cross-Society Experimental Analysis of Three Bargaining Games*

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February 25, 2009.

Abstract. Data from three bargaining games—the Dictator Game, the Ultimatum Game, and the Third-Party Punishment Game—played in 15 societies are presented. The societies range from US undergraduates to Amazonian, Arctic, and African hunter-gatherers. Behaviour within the games varies markedly across societies. The paper investigates whether this behavioural diversity can be explained solely by variations in inequality aversion. Combining a single parameter utility function with the notion of subgame perfection generates a number of testable predictions. While most of these are supported, there are some telling divergences between theory and data: uncertainty and preferences relating to acts of vengeance may have influenced play in the Ultimatum and Third-Party Punishment Games; and a few subjects used the games as an opportunity to engage in costly signalling.

1. Introduction

In 2001, Henrich et. al. introduced data from Ultimatum Games (UGs) conducted in 15 variably remote societies.[1] The data displayed a diversity not seen in UG data before. The societies varied significantly in terms of both their mean offers and their apparent rejection strategies. The study was presented in greater detail and further analysed in an edited volume

Corresponding Author. abigail.barr@economics.ox.ac.uk. **JEL Classifications.** C72, C9, Z13.
Keywords. Bargaining games, cross-cultural experiments, inequality aversion.
The authors would like to thank Godfrey Keller, David Myatt, and Jeremy Tobacman for helpful discussions. Funding from the National Science Foundation (grant number BCS-0136761) is gratefully acknowledged.
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*Dumont (1977) introduced homo æqualis as an alternative to homo hierarchicus, the former being associated with western societies, individualism, freedom, and equality and the latter with eastern societies and values. Here, homo æqualis is more narrowly defined, being associated with a preference for economic equality.
[1]The UG applied in the study was sequential with direct elicitation: two players, Player 1 and Player 2, were endowed with a sum of money. Player 1 proposed a division of the money to Player 2. Player 2 then either accepted or rejected the amount offered by Player 1. If Player 2 accepted the offer then Player 1 received the remainder. If Player 2 rejected the offer, both players received zero.

(Henrich et. al., 2004) and in Henrich et. al. (2005) and generated considerable debate (some of which is documented in the same issue of *Behavioral and Brain Sciences* in 2005). Much of the debate focused on the documented methodological variations across societies and the difficulties in establishing precisely what was driving the observed variations in offers owing to the nature of the UG game and the rareness of rejections in the data. So, between 2001 and 2005 several researchers from the original project and several new recruits returned to the field with an improved experimental design: the UG was rerun, applying the strategy method to the responding players; a simple Dictator Game (DG) was conducted; and a simplified version of the Fehr and Fischbacher (2004) Third-Party Punishment Game (TPG) was also included in the design, with the strategy method applied to the third party. In addition, experimental protocols were tightened to improve comparability across societies and ensure that, in every society, the experimental subjects were representative of, i.e. randomly drawn from, the adult population. The outcome is a very rich dataset that, like its predecessor, shows wide variations in behaviour across societies. However, unlike its predecessor, this new dataset can support tests of hypotheses relating to correlations between different types of behaviour across societies. Thus, Henrich et. al. (2006) were able to show that the data are consistent with the co-evolution of altruism and third-party punishment. The application of the strategy method and the inclusion of three games in the experimental design also facilitates extensive testing of the consistency in cross-society behavioural variations across different games and roles. This paper, having presented the new data in some detail, exploits this aspect of the dataset to the full. It investigates whether cross-society variations in observed behaviour in each of the five active roles in the games can be explained by differences in a single dimension, namely a preference for equality or an aversion to inequality.

Like Henrich et. al. (2004, 2005), this paper builds on the work of Roth, Prasnikar, Okuno-Fujiwara, and Zamir (1991), in that it exploits cross-society variations in an analysis of UG offers. However, it departs from this earlier work in two important respects. First, instead of asking whether, given observed rejection profiles, offering behaviour in each society is consistent with selfish money maximisation, it builds on the notion that whatever preference is manifest in rejecting behaviour should also be manifest in offering behaviour. If the subject samples assigned to each role in each society are independent random draws from the same population, such a match should be evident in the data. However, given the asymmetry in the decisions facing the subjects in the two roles, the match can be identified only if the appropriate model of preferences and strategic interactions is applied and, turning this around, the identification of a match can be taken as evidence that the model applied is correct. Second, the analysis is extended to the DG and TPG as well. Indeed, the DG, the simplest of the three games, is used as the basis for comparison throughout.

In its acknowledgement that behaviour can be both rational and consistent with unselfish preferences, the paper builds on the work of Andreoni and Miller (2002). In its use of cross-role behavioural comparisons as a method for establishing whether behaviour is consistent with a given utility function, the paper builds on the work of Andreoni, Castillo, and Petrie (2003). They conducted both the standard UG, applying the strategy method to the responder, and a modified UG in which responders could, rather than rejecting, shrink both their own and the proposer's payoffs proportionally. However, while they could rely solely on within-subject comparisons, here both within-subject and within-society comparisons need to be exploited. This is because, while all the subjects in Andreoni, Castillo, and Petrie (2003) played as both proposers and responders before knowing which role had actually been assigned to them, many of the subjects in the cross-society study played in only one role. Fortunately, the cross-society variations in behaviour within the dataset are sufficient to support a society-level analysis.

The paper proceeds as follows. In Section 2, after this introduction, the experimental design and key elements of the protocol are described. Then, in Section 3, the resulting data are presented in summary and graphical form. This descriptive analysis brings to the fore not only the behavioural diversity across the fifteen societies selected for the study but also a number of regularities: for example, society mean DG offers vary from 26 to 47 percent of the stake; and in several societies "U-shaped" rejection strategies are observed in the UG.

In Section 4, these regularities guide the choice of a particular utility function that captures the notion of inequality aversion as a basis for the theory. In Section 5, the utility function is combined with the notion of subgame perfection to generate five testable predictions about how people play the DG, UG, and TPG.

In Section 6, each of these predictions is examined and tested. In general, the data provide strong support for the model. Within the context of the DG, UG, and TPG at least, inequality aversion appears to be the principle factor motivating individuals' decisions. Variations in behaviour across societies and across individuals within societies appear to be driven by differences in the value placed upon equality. However, despite the model's overall success, it fails in a few interesting regards: there is evidence that uncertainty and another preference, possibly related to acts of vengeance, affect behaviour and outcomes in the UG and TPG; and a few experimental subjects appear to have treated the games as a signalling opportunity within a meta-game. These failures are discussed in Section 7. Section 8 concludes.

2. Experimental Design

2.1. **The Games.** In the Dictator Game (DG), two players, Player 1 and Player 2, were endowed with a sum of money (the stake). Player 1 divided the money between the players. Player 2 was a passive recipient. Offers were restricted to 10 percent increments of the stake and play was anonymous and one shot.

In the Ultimatum Game (UG), two players, Player 1 and Player 2, were endowed with a sum of money (the stake). Player 1 proposed a division of the stake to Player 2. Player 2, before hearing the actual amount offered by Player 1, decided whether to accept or reject each of the possible offers. Offers again were restricted to 10 percent increments of the stake, so Player 2s made eleven accept/reject decisions and these decisions were binding. If Player 2 specified that the amount of the actual offer would be accepted, then this was the amount they received and Player 1 received the remainder. If Player 2 specified "reject" for the amount of the actual offer, both players received zero. Play was anonymous and one shot.

In the Third-Party Punishment Game (TPG), two players, Player 1 and Player 2, were endowed with a sum of money (the stake), and a third player, Player 3, was endowed with one half of this amount. Player 1 proposed a division of the stake between the first two players. Player 2 was a passive recipient. Player 3, before hearing the actual amount offered by Player 1 to Player 2, decided whether to pay to have Player 1 fined or not in the case of each of the possible offers Player 1 could have made. Offers again were restricted to 10 percent increments of the stake, so Player 3s made eleven do/don't pay-to-fine decisions and these decisions were binding. If Player 3 chose to pay to have Player 1 fined in the case of the actual offer, Player 3 paid 20 percent of his initial endowment (10 percent of the stake) and Player 1 was fined 30 percent of the stake. Play was anonymous and one shot.

Table 1. Experimental Sites

Site	Country	Environs	Economic Base	Residence
Hadza	Tanzania	Savanna/woodlands	Foraging	Nomadic
Tsimane	Bolivia	Tropical forest	Horticulture/foraging	Semi-nomadic
Emory students	US	Temperate forest/urban	Students	Temporary Res.
Gusii	Kenya	Fertile high plains	Mixed farming/waged work	Sedentary
Maragoli	Kenya	Fertile plains	Subsistence farming	Sedentary
Yasawa	Fiji	Coastal tropical island	Horticulture/marine foraging	Sedentary
Shuar	Ecuador	Tropical forest	Horticulture/foraging	Sedentary
Isanga village	Tanzania	Mountainous forest	Mixed farming/waged work	Sedentary
Dolgan/Ngagasan	Russian Fed.	Tundra/taiga	Hunting/fishing/waged work	Semi-sedentary
Samburu	Kenya	Semi-arid savanna	Pastoralism	Semi-nomadic
Sursurunga	PNG	Coastal tropical island	Horticulture	Sedentary
Au	PNG	Mountainous tropical forest	Horticulture/foraging	Sedentary
Accra city	Ghana	Urban, high density	Waged worker	Sedentary
Sanquianga	Colombia	Mangrove forest	Commercial fishing	Sedentary
Rural Missouri	US	Prairie	Mixed farming/waged work	Sedentary

2.2. **The Societies and Subjects.** The principle aim of this program of research was not to provide a representative view of but to explore the diversity in notions of fairness across human societies.[2] This aim is reflected in the diversity of the fifteen societies chosen for the study. They range from US undergraduates, through waged workers in urban Ghana, horticulturalists and waged workers in the US, Kenya, and Tanzania, subsistence and small scale farmers in Kenya and Papua New Guinea, horticulturalists who also forage in Bolivia, Ecuador, Fiji, and Papua New Guinea, hunters and fisher-folk in Colombia and Siberia, and foragers in Tanzania. The names of the societies and a few of their characteristics are reported in Table 1. Within each society, invited subjects were randomly selected from the adult population and, among those invited, non-attendance was rare. Thus, the samples are highly representative of the communities from which they are drawn.

[2]For more about the aims of the project, see `http://www.hss.caltech.edu/roots-of-sociality`.

2.3. **Protocol.** In every society the stake was set close to one day's wage in the local economy, but at a value that rendered it equivalent to (multiples of) ten coins or notes in the local currency. Thus, the subjects could be taught and play the games using real coins or notes. Players were paid a show-up fee roughly equal to 20 percent of one day's wage in the local economy. Show-up fees and winnings from the games were paid in private and in cash at the end of each session.

The goal was to generate 30 data points relating to each role in each society. For each decision (offer or strategy) to have been made by a different individual would have required 150 subjects per society and having the passive roles filled by first-time subjects every time would have required a further 60 subjects per society. Some of the communities were not large enough to provide that many adult subjects. So, some doubling up of roles was built into the original design. Specifically, two types of experimental session were designed. In one, subjects first played the DG and then went on to play the UG. Player 1s in the DG became Player 1s in the UG and the passive Player 2s in the DG became Player 2s in the UG and decided upon their acceptance/rejection strategies before being told what they had received in the DG.[3] In the other type of experimental session, subjects played the TPG.

Table 2. Sample Sizes for Active Player Roles

	Dictator Game	Ultimatum Game		Third-Party Pun. Game	
	Role 1	Role 1	Role 2	Role 1	Role 3
Hadza	31	31	31	27	27
Tsimane	38	36	33	27	23
Emory	19	19	19	22	20
Gusii	25	25	25	30	30
Maragoli	25	25	25	30	30
Yasawa	35	34	34	30	29
Shuar	21	21	20	15	17
Isanga	30	30	30	20	20
Dolgan/Nganasan	30	30	29		
Samburu	31	31	31	30	30
Sursurunga	30	30	29	32	32
Au	30	30	30	30	30
Accra	30	30	30	39	39
Sanquianga	30	30	30	32	32
Rural Missouri	15	26	28		
Full sample	420	428	424	364	359

In each society, the DG and UG sessions were completed first. Then, in several of the societies it was necessary to re-use subjects from these sessions in the passive Player 2 role in the TPG sessions.[4] Among the Hadza, Yasawa, and Shuar it was also necessary to re-use

[3] In Rural Missouri the DG and UG were played in separate sessions using different subjects. This is because the sessions in Rural Missouri were conducted early, in order that the English scripts could be piloted. It was only after this pilot, during a workshop attended by all the researchers, that it was realised that society size would be a constraint in many cases.

[4] Re-used subjects never knew they would be attending a second session when assuming their first active role.

subjects from the DG and UG sessions in active roles in the TPG sessions. The resulting sample sizes relating to each of the active roles in each of the sites is reported in Table 2.

In all sessions the games were presented orally to the subjects as a group using visual aids and real money. Then, one by one, the subjects were called to private meetings with the researcher and in most cases a research assistant fluent in the local language.[5] At these meetings they were talked through the game once more using visual aids and real money, tested to ensure they understood, invited to ask questions, told their randomly assigned role, and invited to make their decision. UG Player 2s and TPG Player 3s, having been told their role, were shown the blank side of a slip of paper, on the reverse of which had been written their Player 1's offer. This slip of paper was placed face down on the table in front of them to remind them that Player 1's decision had already been made and could not be influenced.

Table 3. Session Sizes

	Dictator and Ultimatum Games			Third-Party Pun. Game		
	Mean	Min.	Max.	Mean	Min.	Max.
Hadza	20.32	8	30	30.06	17	39
Tsimane	73.00	73	73	56.01	12	63
Emory	18.62	17	20	64.00	64	64
Gusii	50.00	50	50	90.00	90	90
Maragoli	26.00	20	30	90.00	90	90
Yasawa	17.89	14	20	29.67	29	30
Shuar	30.76	6	35	48.00	48	48
Isanga	20.00	20	20	20.10	18	21
Dolgan/Nganasan	19.68	19	20			
Samburu	62.00	62	62	89.00	89	89
Sursurunga	30.00	30	30	49.69	39	57
Au	60.00	60	60	90.00	90	90
Accra	20.00	20	20	25.00	15	33
Sanquianga	20.00	20	20	33.75	24	42
Rural Missouri (DG)	28.00	28	28			
Rural Missouri (UG)	27.00	27	27			
Full Sample	34.11			54.28		

Note. Means weighted by numbers of subjects.

Both the group training sessions and the one-on-one meetings were fully scripted in English using neutral language. The scripts were translated into each of the local languages and then back translated by independent third parties so that they could be checked for consistency and to ensure that wordings remained as neutral as possible throughout.

The subjects knew that roles and playing partners were to be randomly assigned and, where appropriate, that they were to be randomly re-partnered between the DG and UG. Subjects were called to their one-on-one meetings in a near random order: it could not be perfectly random as Player 2s and 3s could be met only after their Player 1s had made their offers.

[5]Research assistants who were members of the society turned away when subjects made their decisions.

Subjects were asked not to talk to one another about the experiment during the sessions and monitors were assigned to ensure that no-one violated this rule. Subjects who were waiting to play a game were sat separately from subjects who had already played.

For practical reasons, session sizes varied. In some small village societies, running one large DG and UG session involving 60 subjects and one large TPG session involving 90 subjects was the only way to prevent subject contamination. However, such sessions took a very long time to run. So, in societies made up of several geographical clusters between which contamination was unlikely and transportation was an issue, several smaller sessions were run. Mean, minimum, and maximum session sizes for each society are reported in Table 3.

All participants knew everything about the games they were asked to play, except who was matched with whom. The scripts specified that players were matched with (an)other person(s) from their village, workplace, or town, but made it clear no-one would ever know who was matched with whom. The scripts also made it clear that the games were one shot.

3. Experimental Data

The data generated by the experimental sessions in each society are presented in Figures 1, 2, and 3 and in summary form in Table 4. Figure 1 presents histograms of the DG and UG offers in each society, while the first two columns of Table 4 present the corresponding mean DG and UG offers. Both the histograms and the rows in the table have been ordered with reference to the mean DG offer in each society. The histograms and table reveal both considerable diversity and some marked patterns in the data. First, note the wide variation in mean offers across societies. The mean DG offer varies from 0.26 of the stake among the Hadza and the Tsimane to 0.47 among the Sanquianga and the Rural Missourians; the mean UG offer varies from 0.25 among the Maragoli to 0.51 among the Sursurunga. Second, across all societies both DG and UG offers above 0.5 of the stake are rare. So, as the mean DG offer rises, the DG offers tend to become increasingly concentrated at and around 0.5. Second, the distributions in DG and UG offers are very similar within each society with the latter tending to be only marginally to the right of the former. Third, in societies with lower mean DG offers, the distribution of DG offers tends to have greater weight at the left-hand end relative to the distribution of UG offers. Finally, two societies stand out: the Gusii with particularly pronounced modes at 0.3 in the DG and 0.4 in the UG; and the Maragoli who made significantly lower offers in the UG.

Figure 2 presents histograms of UG offers in each society overlaid by the mean UG rejection/acceptance strategies.[6] The third column of Table 4 presents the mean minimum acceptable offer (the mean of the lowest offer that each Player 2 was willing to accept) in each society. The fourth column presents the mean maximum acceptable offer (the mean of the highest offer that each Player 2 was willing to accept) in each society. The ordering of the

[6]The proportion of Player 2s accepting any given offer can be read from the right-hand vertical axis.

FIGURE 1. Offers in the Dictator (□) and Ultimatum Games (■)

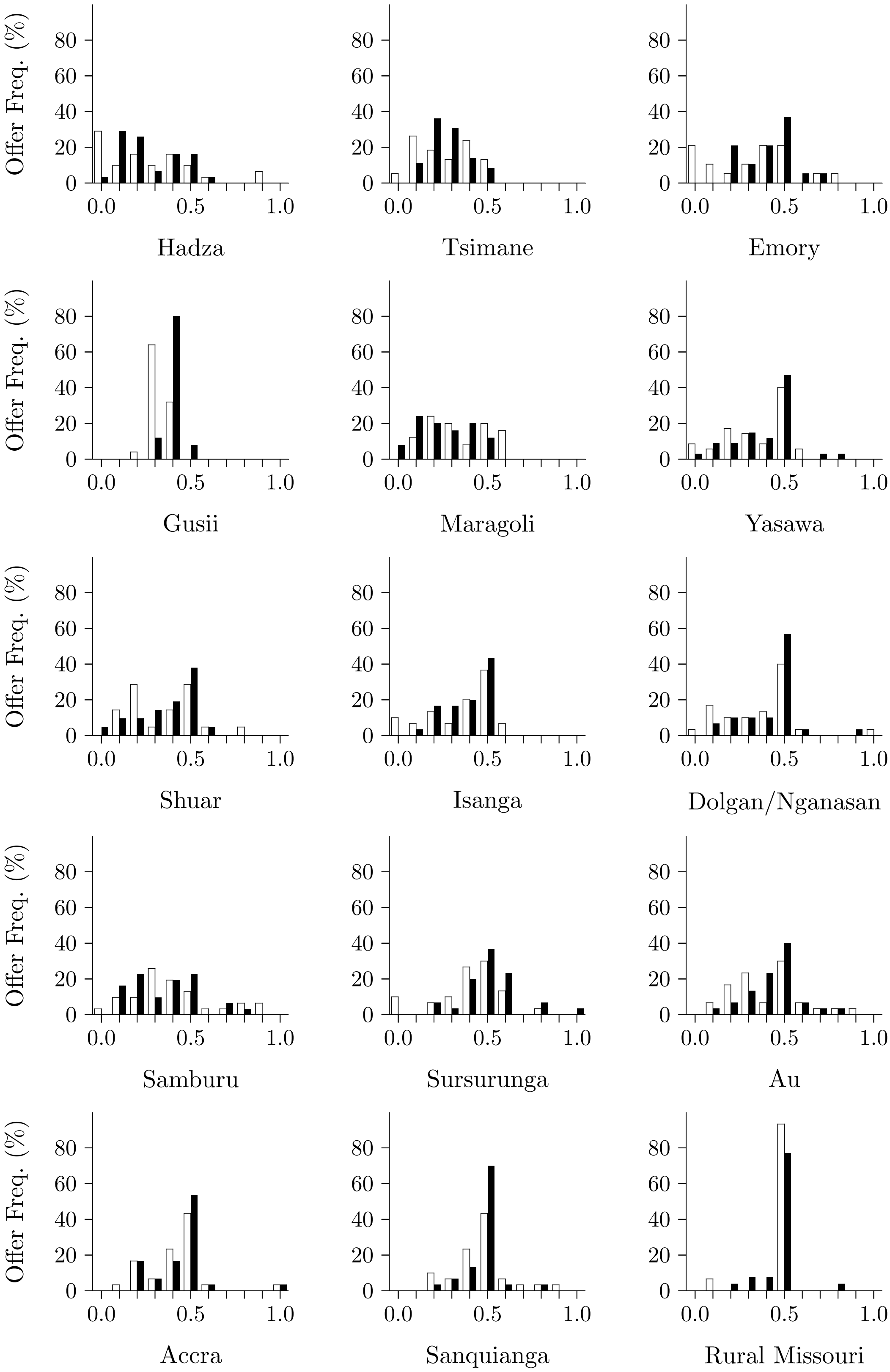


Figure 2. Offers (■) versus Acceptance Levels (▲) in the Ultimatum Game

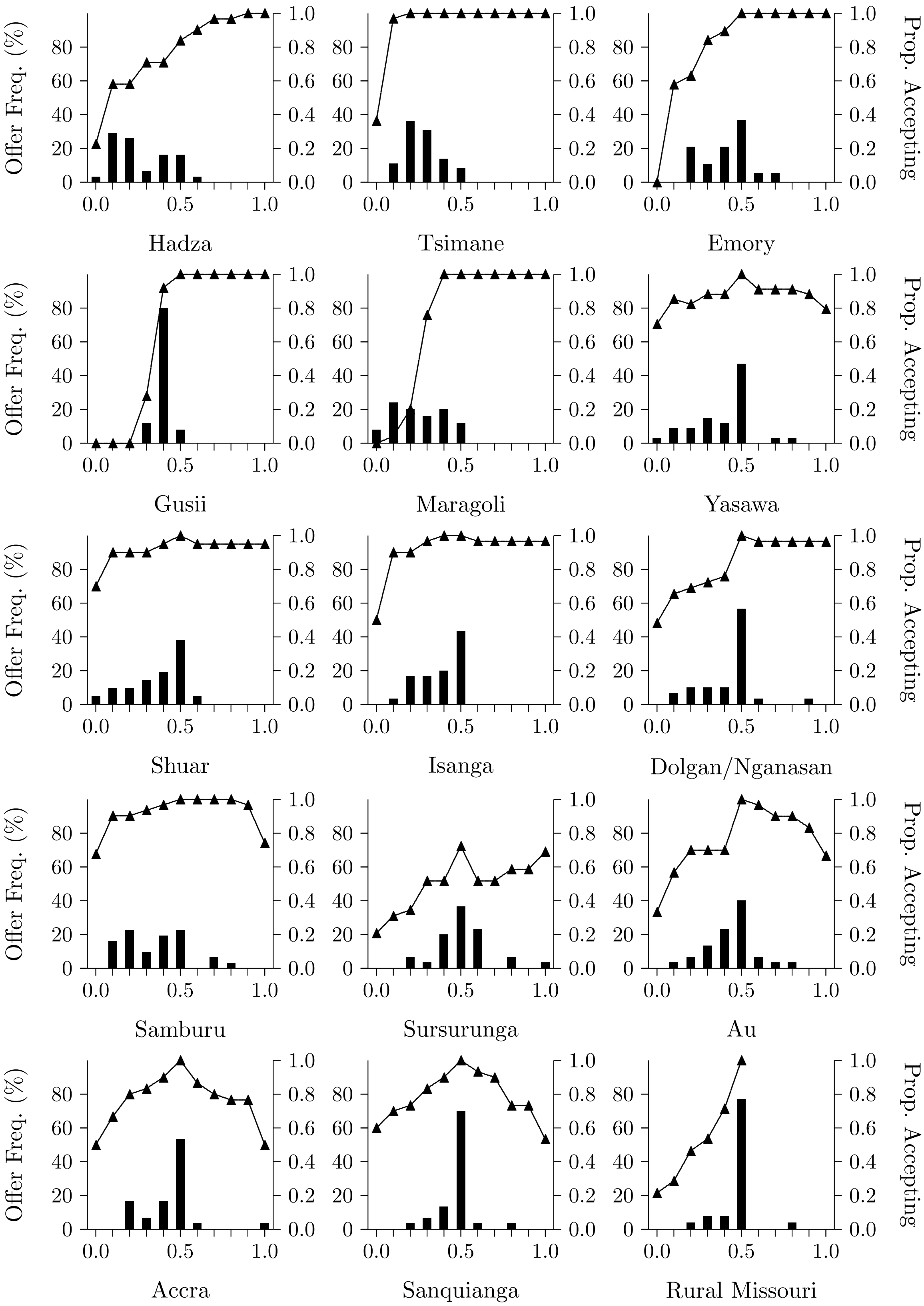


FIGURE 3. Offers (■) and Fining (▼) in the Third-Party Punishment Game

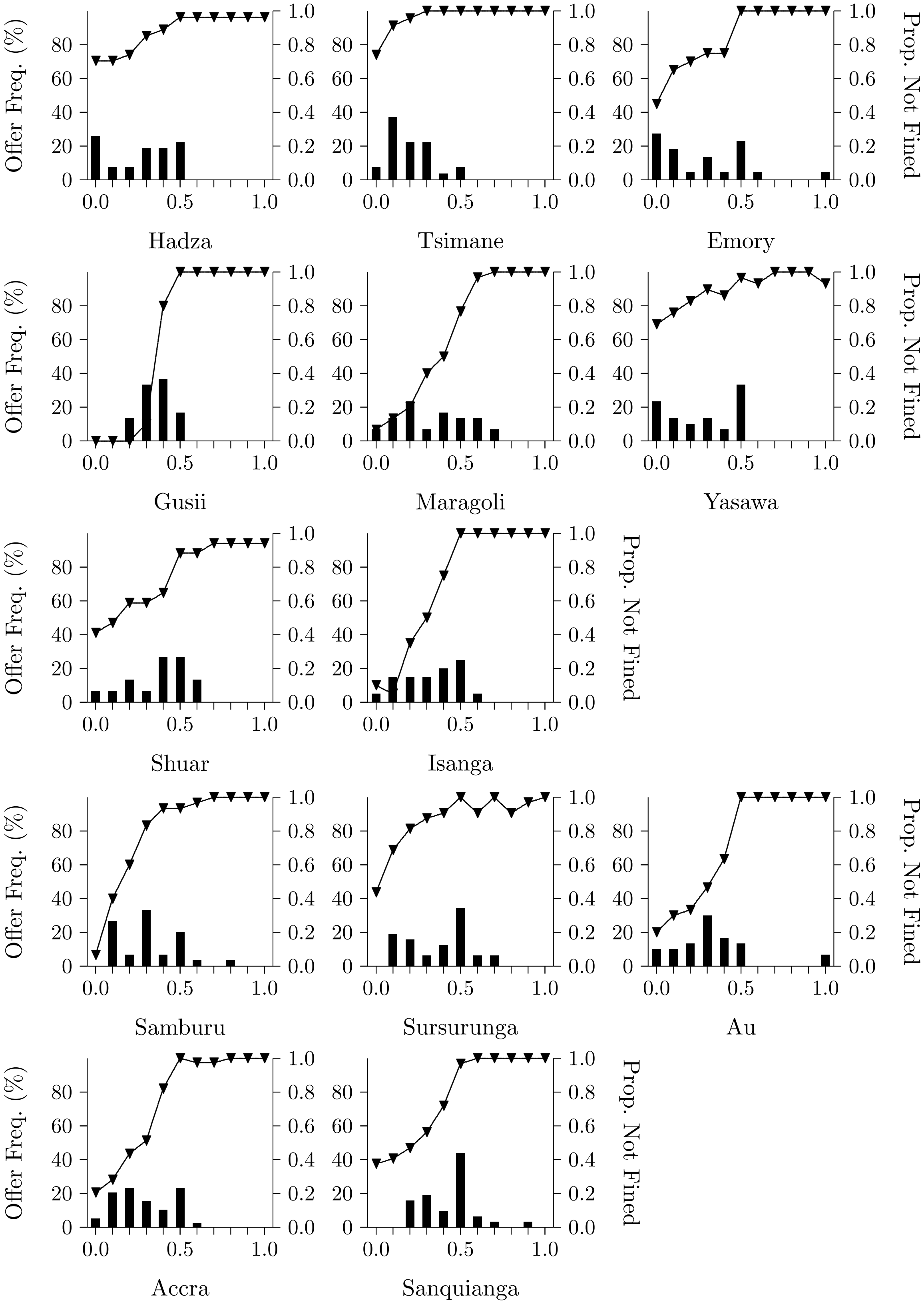


Table 4. Mean Offers, Rejection, and Fining Strategies

	Dictator Game	Ultimatum Game			Third-Party Pun. Game	
	Mean Offer	Mean Offer	Min. AO	Max. AO	Mean Offer	Min. UO
Hadza	0.26 (0.25)	0.26 (0.17)	0.25 (0.26)	1.00 (0.00)	0.26 (0.19)	0.09 (0.17)
Tsimane	0.26 (0.15)	0.27 (0.11)	0.07 (0.05)	1.00 (0.00)	0.20 (0.13)	0.04 (0.08)
Emory	0.32 (0.24)	0.41 (0.14)	0.21 (0.14)	1.00 (0.00)	0.27 (0.27)	0.16 (0.20)
Gusii	0.33 (0.05)	0.40 (0.05)	0.38 (0.06)	1.00 (0.00)	0.36 (0.09)	0.41 (0.05)
Maragoli	0.35 (0.17)	0.25 (0.16)	0.30 (0.08)	1.00 (0.00)	0.34 (0.21)	0.40 (0.19)
Yasawa	0.35 (0.18)	0.40 (0.17)	0.06 (0.13)	0.95 (0.13)	0.27 (0.20)	0.07 (0.15)
Shuar	0.35 (0.19)	0.37 (0.17)	0.07 (0.14)	0.98 (0.11)	0.37 (0.18)	0.23 (0.25)
Isanga	0.36 (0.18)	0.38 (0.13)	0.07 (0.10)	0.98 (0.09)	0.33 (0.17)	0.31 (0.16)
Dolgan/Nganasan	0.37 (0.21)	0.43 (0.16)	0.15 (0.20)	0.98 (0.09)		
Samburu	0.40 (0.23)	0.35 (0.19)	0.06 (0.12)	0.97 (0.05)	0.31 (0.18)	0.22 (0.16)
Sursurunga	0.41 (0.19)	0.51 (0.16)	0.37 (0.32)	0.83 (0.27)	0.37 (0.19)	0.10 (0.13)
Au	0.41 (0.20)	0.44 (0.15)	0.20 (0.21)	0.93 (0.14)	0.33 (0.23)	0.31 (0.20)
Accra	0.42 (0.17)	0.44 (0.16)	0.13 (0.17)	0.88 (0.17)	0.28 (0.17)	0.26 (0.18)
Sanquianga	0.47 (0.16)	0.48 (0.10)	0.12 (0.18)	0.88 (0.16)	0.43 (0.16)	0.25 (0.22)
Rural Missouri	0.47 (0.10)	0.48 (0.10)	0.28 (0.20)			
Full sample	0.37 (0.19)	0.39 (0.16)	0.18 (0.20)	0.95 (0.13)	0.32 (0.19)	0.22 (0.20)

Note. Standard errors in parentheses. An agnostic and literal approach is used to identify each subject's UG Min. and Max. AO and TPG Min. UO. So, UG Min. AOs and TPG Min. UOs can be greater than 0.5, UG Max. AOs can be less than 0.5, apparently inconsistent strategies are coded, and only two strategies, in which all offers are fined, are excluded from the analysis.

graphs is identical to that in Figure 1—it relates to mean DG offers. Here, once again, there is considerable variation in behaviour across societies. In some, such as the Yasawa, Shuar, and Samburu, rejections are rare, while in others, such as the Gusii and the Maragoli, there is almost unanimous rejection of low offers. The most striking feature of this figure, however, is that in some societies several Player 2s chose to reject not only low but also high offers. The mean maximum acceptable offer is 1.0 in only five societies and is lowest, at 0.83, among the Sursurunga. Further, note that the rejections of high offers are concentrated towards the bottom of the figure, i.e., in the societies where mean DG offers are relatively high.[7] Finally, except among the Sursurunga and the Hadza, offers of 0.5 were never rejected.

[7]The absence of the right-hand side of the mean acceptance/rejection strategy in the graph for Rural Missouri is, again, owing to the fact that this site acted as a pilot for the scripts and protocols, and it was only in the subsequent research team workshop that the enumeration of the full strategy was decided upon.

Figure 3 presents histograms of TPG offers in each society overlaid by the mean TPG do/don't pay-to-fine strategies.[8] The fifth column of Table 4 presents the mean TPG offers for each society and the sixth column presents the mean minimum unfined offer (the mean of lowest offers that each Player 3 chose not to pay to have fined) in each society. The graphs are ordered identically to those in Figure 1 (by mean DG offers). Once again, behaviour varies markedly across societies. The Hadza, Tsimane, and Yasawa rarely fine, while in most of the other societies the fining of low offers is commonplace. Also, the offer distributions tend to be to the left of the corresponding distributions of DG offers. Finally, in contrast to the UG acceptance/rejection strategies, the do/don't fine strategies tend to be monotonic, with the few instances where offers greater than 0.5 attracted a fine appearing as inconsistencies.

4. Modelling Inequality Aversion

That many of the observed offers are greater than zero is consistent with the existence of unconditional altruism. However, unconditional altruism cannot explain rejections or fines.[9] The rejection of low offers could be viewed as evidence of a type of negative reciprocity; but the rejection of high offers cannot, and neither can the fining of low offers by third parties.[10] One motivation that can explain all these features is inequality aversion; but can variations in this single motivation across societies and individuals explain all the behavioural variations in the data? To address this question, a simple model based on a well-behaved utility function that exhibits inequality aversion is developed. The approach has the "separability" property discussed by Camerer (2003, p. 111) in that the apparatus of (subgame-perfect) equilibrium is left intact; preferences alone depart from the standard textbook treatment of game theory.

One way to model inequality aversion would be to follow the work of Fehr and Schmidt (1999) and assume that players' utilities are (linearly) increasing in the monetary amount they receive, but (linearly) decreasing in the absolute monetary difference between the amount they receive and the amount received by other players.[11] However, as they stated, and Camerer (2003, Ch. 2) noted, the optimal offer in a DG when inequality aversion is piecewise linear has an extreme property: offers should be either fifty-fifty or zero, in their own words "a prediction that is clearly refuted by the data" (Fehr and Schmidt, 1999, p. 848).[12] They observed that "a utility function that is concave in the amount of advantageous inequality [would generate] optimal offers that are in the interior of $[0, 0.5]$" (ibid.). This is precisely the

[8]The proportion of Player 3s choosing not to fine a given offer can be read from the right-hand vertical axis.
[9]For example, Andreoni and Miller (2002) estimated a CES utility function in which the monetary payoff received by another enters: rejection in the UG and fining in the TPG cannot be captured by this approach.
[10]Following in the spirit of the "fairness equilibrium" of Rabin (1993), Falk and Fischbacher (2006) introduced the notion of a "reciprocity equilibrium". The prediction in the DG is identical to the one here (see Lemma 1, with $\alpha = \rho_1 \times \varepsilon_1$ in their notation). However, reciprocity equilibrium in the UG always involves acceptance of offers greater than 50% (Prop. 1, pp. 303–304, op. cit.). The "sequential reciprocity equilibrium" of Dufwenberg and Kirchsteiger (2004) has the same feature. See Camerer (2003) for a detailed discussion.
[11]Charness and Rabin (2002) took a similar approach with fewer restrictions on the signs of the parameters.
[12]Such a prediction is clearly refuted by the data here as well, as Figure 1 illustrates.

approach taken here. Moreover, using such a utility function admits a "U-shaped" rejection function in the UG whereby very high offers as well as very low offers may be optimally rejected—a key feature apparent from Figure 2.

A particularly simple one-parameter specification is proposed here: players' utilities are assumed to be increasing in the monetary amount received, but decreasing in the empirical variance of the monetary amounts received by the set of all players. Player i receives utility

$$u_i = x_i - \frac{\alpha}{n}\left[\sum_{j=1}^{n}(x_j - \bar{x})^2\right], \tag{1}$$

where x_j is the monetary payoff received by Player j, n is the number of players in the game, and $\bar{x} \equiv \frac{1}{n}\sum_{j=1}^{n} x_j$ is the mean monetary payoff. $\alpha \geq 0$ is a parameter measuring the degree of inequality aversion. If $\alpha = 0$ the players do not care about inequality: utilities and monetary payoffs coincide. As $\alpha \to \infty$, players find inequality more and more distasteful.

The specification of (1) for the UG can be viewed as an appropriately parameterised version of the quadratic utility function used by Andreoni, Castillo, and Petrie (2005). They estimated such functions for various UGs; and although they did not extend the approach to n-player games, (1) is consistent with a natural generalisation of their approach to larger games.

In their "ERC" model, Bolton and Ockenfels (2000) proposed a utility function of the form

$$u_i = v_i\left(x_i, \frac{x_i}{\sum_{j=1}^{n} x_j}\right), \tag{2}$$

with the second argument assumed to be $\frac{1}{n}$ whenever $\sum_{j=1}^{n} x_j = 0$. Fixing the second argument, the function v_i is increasing in x_i; fixing the first argument, v_i is maximised when the second is $\frac{1}{n}$. For the UG, the specification of (1) can be rewritten in this form. However, the TPG presents a problem for the utility function in (2). In particular, the third party will never fine. This is because, with no fining, the two arguments of v_3 are $\frac{1}{2}$ and $\frac{1}{3} = \frac{1}{n}$ respectively. A fine induces a monetary cost to the finer (strictly reducing the first argument) and (almost always) a change to the latter, thus necessarily reducing v_3. However, both the Fehr and Fischbacher (2004) data and the data above indicate that some offers are fined.

5. Equilibrium and Five Predictions

This section uses the utility function in (1) to generate predictions about play in the three games described above. First, the subgame-perfect equilibria of the DG (Section 5.1), the UG (Section 5.2), and the TPG (Section 5.3) are characterised under the assumption that players are inequality averse. Then, Section 5.4 sets out five testable predictions, one relating to behaviours and outcomes that should not be observed, and four focusing on how behaviour in each of the four active roles in the UG and TPG relates to behaviour in the DG.

5.1. **The Dictator Game.** Define the monetary payoffs to Player 1 and 2 respectively as (x_1, x_2). From (1), inequality-averse players receive utility

$$u_i = x_i - \frac{\alpha}{2}\left[\sum_{j=1}^{2}(x_j - \bar{x})^2\right] = x_i - \frac{\alpha}{4}(x_1 - x_2)^2. \quad (3)$$

Normalising the size of the stake to 1 (the same is done for each of the three games), the equilibrium offer is found simply by substituting $x_1 = 1 - x_2$ and maximising Player 1's payoff u_1 with respect to the offer (x_2):

$$u_1 = 1 - x_2 - \frac{\alpha}{4}(1 - 2x_2)^2 \quad \text{so that} \quad \frac{\partial u_1}{\partial x_2} = -1 + \alpha(1 - 2x_2).$$

This yields an immediate characterisation of the equilibrium offer.

Lemma 1. *In the Dictator Game, Player 1 makes Player 2 an offer of $x_{DG} = x^*_{DG}$, where*

$$x^*_{DG} = \begin{cases} \frac{1}{2} - \frac{1}{2\alpha} & \text{if } \alpha \geq 1, \\ 0 & \text{if } \alpha < 1. \end{cases}$$

The equilibrium offer is increasing in α: the more inequality averse the players, the higher the fraction of the surplus Player 2 receives. Player 1 never gives more than half: $x^*_{DG} < \frac{1}{2}$.

5.2. **The Ultimatum Game.** For different values of α the (subgame-perfect) equilibrium in the UG has different properties. Working backwards, Player 2 accepts any offer resulting in $u_2 \geq 0$ (since rejecting the offer always results in a zero payoff). Hence, using (3), if the offer is x_{UG} (so that, if Player 2 accepts, $x_2 = x_{UG}$ and $x_1 = 1 - x_{UG}$), Player 2 accepts if

$$x_{UG} - \frac{\alpha}{4}(1 - 2x_{UG})^2 \geq 0.$$

Player 2's equilibrium strategy is: accept if $x_{UG} \in [x^{\min}, x^{\max}]$ and reject otherwise, where

$$x^{\min} = \frac{1}{2} + \frac{1}{2\alpha}\left(1 - \sqrt{1 + 2\alpha}\right) \quad \text{and} \quad x^{\max} = \min\left[1, \frac{1}{2} + \frac{1}{2\alpha}\left(1 + \sqrt{1 + 2\alpha}\right)\right].$$

For $\alpha > 4$ note that $x^{\max} < 1$. The equilibrium has a "U-shaped" rejection function for Player 2: very high and very low offers are rejected. As Lemma 2 will demonstrate, however, Player 2's strategy is never binding for Player 1's offer for such high values of α: given Player 1's inequality aversion, the optimal offer to Player 2 satisfies $x^{\min} < x^*_{UG} < x^{\max}$.[13]

Lemma 2. *In the Ultimatum Game, Player 1 makes Player 2 an offer of $x_{UG} = x^*_{UG}$, where*

$$x^*_{UG} = \begin{cases} \frac{1}{2} - \frac{1}{2\alpha} & \text{if } \alpha \geq \frac{3}{2}, \\ x^{\min} & \text{if } \alpha < \frac{3}{2}. \end{cases}$$

Player 2 accepts if $x_{UG} \in [x^{\min}, x^{\max}]$ and rejects otherwise. In equilibrium, the offer is always accepted ($x^*_{UG} \in [x^{\min}, x^{\max}]$) and increasing in α. Player 2's rejection function is "U-shaped" for $\alpha > 4$. When $\alpha \geq \frac{3}{2}$ note that $x^*_{UG} = x^*_{DG}$; and both $x^*_{UG} \geq \frac{1}{6}$ and $x^{\min} \geq \frac{1}{6}$.

[13]This may explain why in Henrich et. al. (2004; 2005) mean offers tend to exceed income-maximising offers.

5.3. **The Third-Party Punishment Game.** Recall that, if Player 3 chooses to fine Player 1 this costs Player 3 $c = \frac{1}{10}$ and Player 1 $p = \frac{3}{10}$. Utilities (now with $n = 3$) are as given in (1). Player 3 is originally endowed with a surplus of $x_3 = \frac{1}{2}$. To compute the subgame-perfect equilibrium, first consider Player 3's choice. $\bar{x} = \frac{1}{2}$ if there is no fine; $\bar{x} = \frac{1}{2} - \frac{1}{3}(c+p) = \frac{11}{30}$ if Player 3 fines Player 1. If Player 1 gives Player 2 an amount x_{TPG}, and substituting in for values of c, p, and $\bar{x}$, Player 3 will fine if

$$\frac{2}{5} - \frac{\alpha}{3}\left[\left(1 - x_{TPG} - \frac{2}{3}\right)^2 + \left(x_{TPG} - \frac{11}{30}\right)^2 + \left(\frac{1}{30}\right)^2\right] > \frac{1}{2} - \frac{\alpha}{6}(1 - 2x_{TPG})^2.$$

This reduces to give a minimum unfined offer of

$$x^{\text{fine}} = \max\left[0, \frac{19}{45} - \frac{1}{2\alpha}\right],$$

any $x_{TPG} < x^{\text{fine}}$ results in a fine from Player 3. Following some straightforward (although cumbersome) algebra it is then possible to characterise the equilibrium for this game.

Lemma 3. *In the Third-Party Punishment Game, Player 1 chooses $x_{TPG} = x^*_{TPG}$, where*

$$x^*_{TPG} = \begin{cases} \frac{1}{2} - \frac{3}{4\alpha} & \text{if } \alpha \geq \frac{45}{14}, \\ x^{\text{fine}} & \text{if } \alpha < \frac{45}{14}. \end{cases}$$

Player 3 fines if and only if $x_{TPG} < x^{\text{fine}}$. In equilibrium, Player 3 never fines ($x^*_{TPG} \geq x^{\text{fine}}$) and x^*_{TPG} is increasing in α. For $\alpha < \frac{45}{38}$ Player 3 sets $x^{\text{fine}} = 0$ and Player 1 gives $x^*_{TPG} = 0$.

5.4. **Theoretical Predictions.** The first prediction is a very straightforward corollary to Lemmas 1-3, and concerns some general features of the equilibria in the three games.

Prediction 1. *No offer should exceed $\frac{1}{2}$ in any of the games: $\max[x^*_{DG}, x^*_{UG}, x^*_{TPG}] \leq \frac{1}{2}$. Offers of $\frac{1}{2}$ should never be rejected in the Ultimatum Game: $x^{\min} < \frac{1}{2} < x^{\max}$. Offers weakly greater than $\frac{1}{2}$ should never be fined in the Third-Party Punishment Game: $x^{\text{fine}} < \frac{1}{2}$. Equilibrium offers are never rejected and never fined: $x^*_{UG} \in [x^{\min}, x^{\max}]$ and $x^*_{TPG} \geq x^{\text{fine}}$.*

The remaining four predictions describe how behaviours should be related across games and roles, assuming that they are driven by the same underlying utility function and value of α.

Prediction 2. *Figure 4 shows how $x^{\min}$ and $x^{\max}$ vary with x^*_{DG}. For $x^*_{DG} > 0$, $x^{\min}$ is increasing and convex. $x^*_{DG} = x^{\min}$ at $\frac{1}{6}$ (shown by the dotted line in the left-hand panel) and at 0 and $\frac{1}{2}$. For all values of $x^{\min} \leq 1 - \frac{\sqrt{3}}{2}$, $x^*_{DG} = 0$. $x^{\max}$ is weakly decreasing and concave in x^*_{DG}. $x^{\max} = 1$ for all values of $x^*_{DG} \leq \frac{3}{8}$ (shown by the dotted line in the right-hand panel); for all values of $x^*_{DG} > \frac{3}{8}$, the rejection function in the Ultimatum Game is "U-shaped".*

Prediction 3. *Figure 5 illustrates how x^*_{UG} varies with x^*_{DG}. For $x^*_{DG} \leq \frac{1}{6}$ (the short dotted line), $x^*_{UG} = x^{\min}$; any offer $x^*_{UG} \leq 1 - \frac{\sqrt{3}}{2}$ is consistent with $x^*_{DG} = 0$. Above $\frac{1}{6}$, $x^*_{UG} = x^*_{DG}$; the long dotted line, at $\frac{3}{8}$, indicates the point where rejections become "U-shaped"; Ultimatum Game offers should be (weakly) larger than Dictator Game offers, $x^*_{UG} \geq x^*_{DG}$.*

Figure 4. Dictator Offers vs. Ultimatum Rejection Strategies

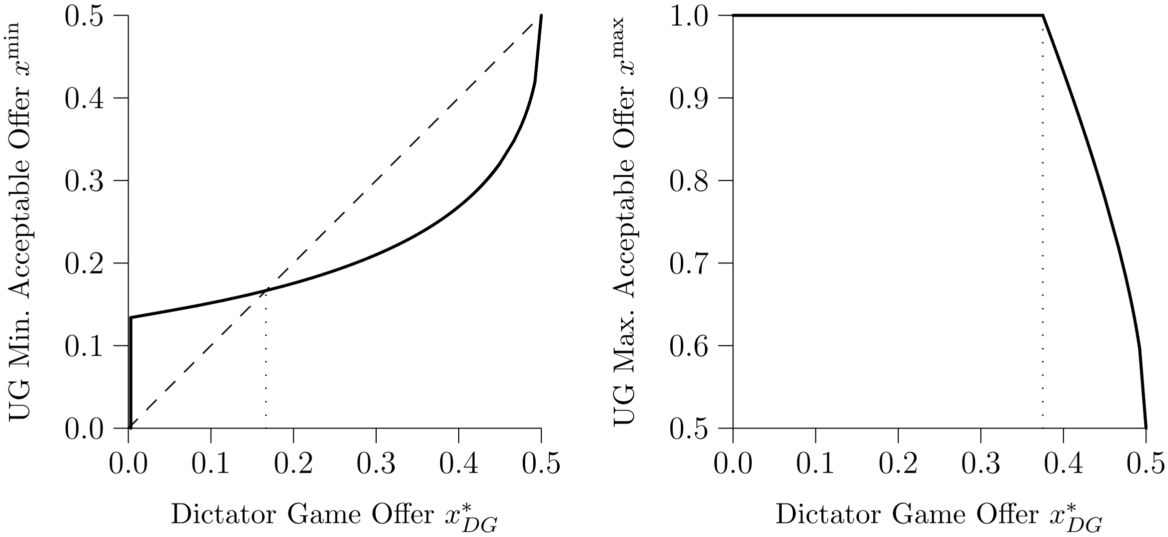
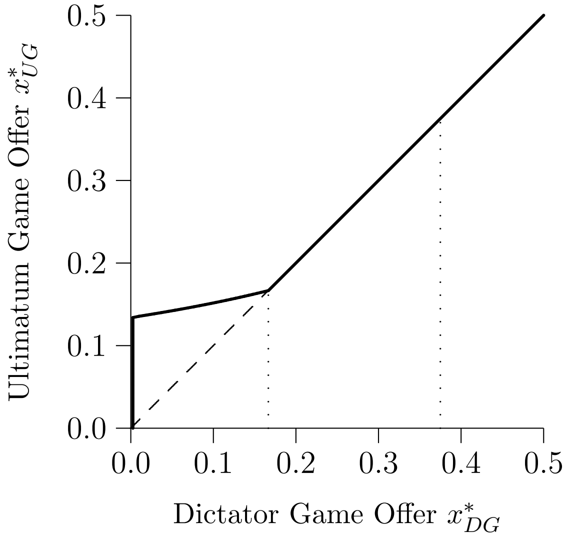


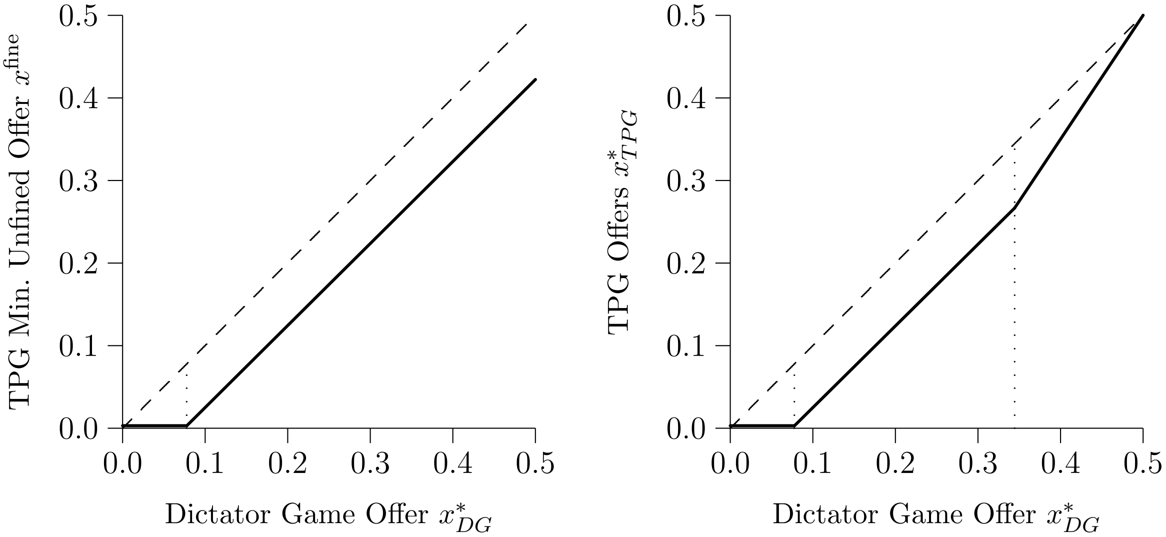
Figure 5. Dictator vs. Ultimatum Offers



Prediction 4. *The left-hand panel in Figure 6 illustrates how x^{fine} varies with x^*_{DG}. When offers in the Dictator Game are low, $x^*_{DG} \leq \frac{7}{90}$, Player 3 should not fine at all: $x^{\text{fine}} = 0$. The minimum offer required to avoid a fine then increases linearly with x^*_{DG}, with slope 1.*

Prediction 5. *The right-hand panel in Figure 6 illustrates how x^*_{TPG} varies with x^*_{DG}. The equilibrium offer is constrained ($x^*_{TPG} = x^{\text{fine}}$) for $x^*_{DG} \leq \frac{31}{90}$, then increases linearly with slope $\frac{3}{2}$ until $\frac{1}{2}$; offers in the Dictator Game should be larger than those in the Third-Party Punishment Game, $x^*_{DG} \geq x^*_{TPG}$.*

Figure 6. Dictator Offers vs. Third-Party Punishment Game



6. Testing the Predictions

6.1. **High Offers, Rejections, and Fines.** The proportion of offers that violate Prediction 1 by exceeding 0.5 in each game and society is reported in Table 5. As noted above, offers exceeding 0.5 are rare. They represent 10 percent of the sample of DG offers and 7 percent of the samples of UG and TPG offers. However, given the efforts made to both maximise and test subject understanding prior to eliciting their decisions, it would be inappropriate to ascribe these offers to error, especially among the Sursurunga, 33 percent of whom made offers greater than 0.5 in the UG, and the Maragoli, 20 percent of whom made offers greater than 0.5 in the TPG.

Table 5. High Offers

	Dictator Game Prop. Offers > 0.5	Ultimatum Game Prop. Offers > 0.5	Third-Party Pun. Game Prop. Offers > 0.5
Hadza	10%	3%	0%
Tsimane	0%	0%	0%
Emory	11%	11%	9%
Gusii	0%	0%	0%
Maragoli	16%	0%	20%
Yasawa	6%	6%	0%
Shuar	10%	5%	13%
Isanga	7%	0%	5%
Dolgan/Nganasan	7%	7%	
Samburu	19%	10%	7%
Sursurunga	17%	33%	13%
Au	17%	13%	7%
Accra	7%	7%	3%
Sanquianga	17%	7%	13%
Rural Missouri	0%	4%	
Full Sample	10%	7%	7%

TABLE 6. Incidence of Rejection and Fining

	Ultimatum Game		Third-Party Pun. Game	
	Proportion Rejecting 0.5	Incidence of Rejection	Proportion Fining ≥ 0.5	Incidence of Fining
Hadza	16%	35%	4%	17%
Tsimane	0%	0.3%	0%	6%
Emory	0%	12%	0%	27%
Gusii	0%	15%	0%	51%
Maragoli	0%	51%	23%	52%
Yasawa	0%	7%	14%	16%
Shuar	0%	6%	12%	30%
Isanga	0%	3%	0%	41%
Dolgan/Nganasan	0%	11%		
Samburu	0%	5%	7%	26%
Sursurunga	28%	41%	13%	11%
Au	0%	15%	0%	46%
Accra	0%	8%	5%	41%
Sanquianga	0%	4%	3%	21%
Rural Missouri	0%	8%		
Full sample	3%	14%	6%	30%

Note. "Incidence of rejection" is the proportion of all possible pairings of offers and rejection strategies within sites leading to a rejection in the UG; "incidence of fining" is the proportion of all possible pairings of offers and fining strategies within sites leading to a fine in the TPG.

The first column in Table 6 reports the proportion of Player 2s in the UG rejecting offers of 0.5 in each of the societies and across all societies. Such rejections occur in only two societies: the Hadza and the Sursurunga. Overall, only 3 percent of UG Player 2s reject offers of 0.5.

The third column in Table 6 reports the proportion of Player 3s in the TPG who fine offers of 0.5 and above in each of the societies and across all societies. In general, the fining of high offers is rare; only 6 percent of TPG Player 3s displayed such behaviour. However, among the Maragoli, 23 percent fined offers of 0.5 and a few fined offers of 0.6.

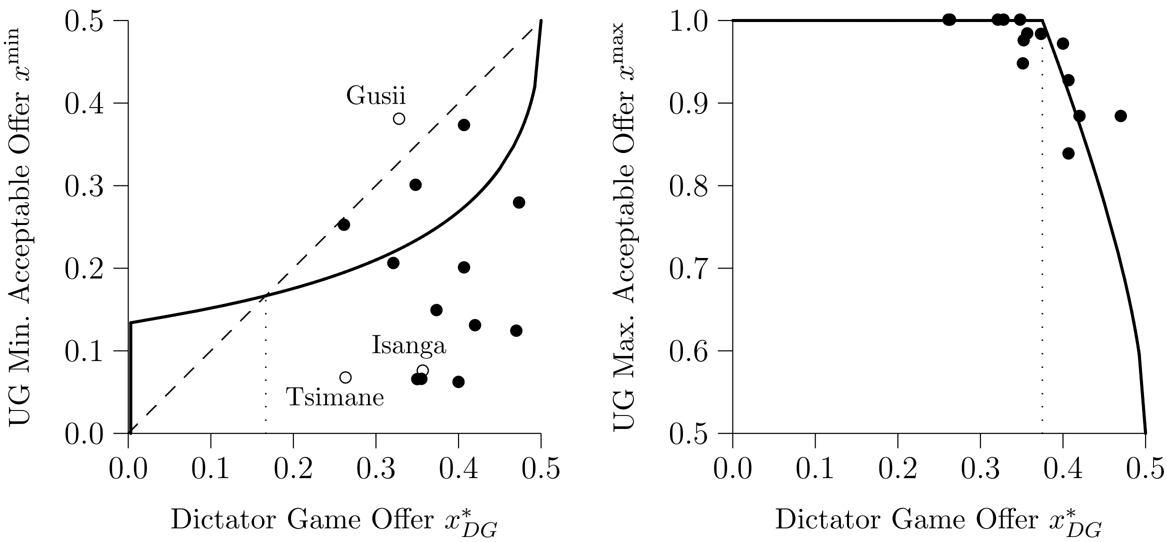
The last part of Prediction 1 is tested by examining the incidence of rejections in the UG and fines in the TPG across the entire subject sample and within each society one at a time. In the experiments, each subject was randomly matched with one other from their own society in the UG and two others in the TPG. One method for testing this prediction would be to look at the incidence of actual rejections and fines within these random matches. However, the prediction can be tested with greater accuracy if, instead of restricting the analysis to actual subject matches, all the possible matches are analysed—Player 1 to Player 2 in the UG and Player 1 to Player 3 in the TPG—within each society. The results of this exercise are reported in the second and fourth columns of Table 6.

Across all societies, the rejection incidence in the UG is 14 percent. However, there is marked variation in this proportion across societies. Among the Hadza, Maragoli, and Sursurunga, the incidence of rejection is 35, 51, and 41 percent respectively. Figure 2 indicates that the high incidence of rejection among the Maragoli results from many low offers being made and rejected. Among the Sursurunga the high incidence results from the rejection of offers of 0.5. Finally, among the Hadza, the high incidence results from a mixture of these two causes. If these three societies are excluded from the analysis, the overall rejection rate is 7 percent.

Compared to rejections, fines are commonplace. Across all societies, the fining incidence is 30 percent. It is greatest among the Gusii and Maragoli at 51 and 52 percent respectively, but is less than 15 percent in only two societies: the Tsimane and Sursurunga.

6.2. **DG Offers and UG Rejection Strategies.** DG Player 1s never assumed the role of UG Player 2s, so Prediction 2 can be investigated only at the society level.[14] Superimposing society mean minimum and maximum acceptable offers plotted against society mean DG offers on the graphs relating to Prediction 2 above returns Figure 7.

FIGURE 7. Predictions versus Data for Rejections in the Ultimatum Game



There is no apparent relationship between society mean DG offers and UG minimum acceptable offers; most of the data points are markedly below and to the right of the predicted relationship. However, treating the predicted relationship as a null hypothesis, bootstrap tests involving 1,000 random draws from the distributions of the estimated mean DG offer and mean UG minimum acceptable offer for each society indicate that the predicted relationship can be rejected for only three societies: the point for the Gusii is significantly (1 percent level) above; the points for the Isanga and the Tsimane are significantly (10 and 5 percent level respectively) below.

[14]To establish that there is sufficient cross-society variation in behaviour to support such an analysis, three subject-level regressions taking DG offers, UG minimum acceptable offers, and UG maximum acceptable offers as their respective dependent variables and a full set of society indicators as their explanatory variables were conducted. All three regressions were highly significant, indicating that a society-level analysis will be informative. The regressions are reported in Table 7.

TABLE 7. Regressions of Behavioural Variables on Society Indicators

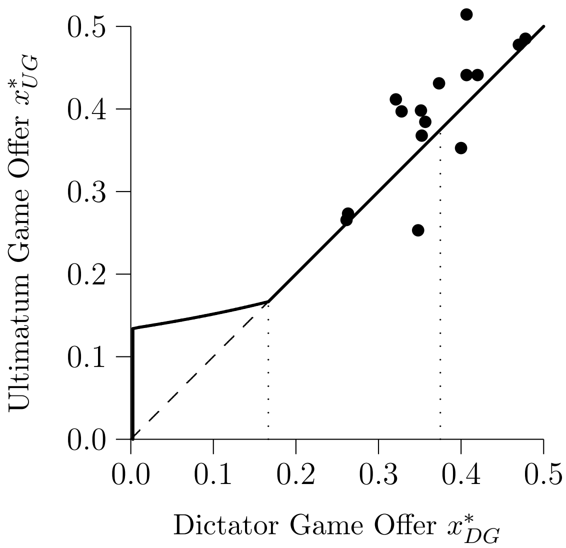
	1		2		3		4		5		6	
	x_{DG}		x_{UG}		$x^{\min}$		$x^{\max}$		x_{TPG}		x^{fine}	
	Coeff.	s.e.	Coeff.	s.e.	Coeff.	s.e.	Coeff.	s.e.	Coeff.	s.e.	Coeff.	s.e.
Constant	0.420	0.018***	0.440	0.029***	0.130	0.039***	0.883	0.010***	0.285	0.008***	0.262	0.026***
Hadza	-0.159	0.029***	-0.175	0.032***	0.122	0.081	0.117	0.010***	-0.022	0.049	-0.169	0.068**
Tsimane	-0.157	0.018***	-0.168	0.029***	-0.063	0.039	0.117	0.010***	-0.085	0.010***	-0.222	0.026***
Emory	-0.099	0.056*	-0.029	0.054	0.075	0.047	0.117	0.010***	-0.012	0.008	-0.102	0.026***
Gusii	-0.092	0.018***	-0.044	0.029	0.250	0.039***	0.117	0.010***	0.072	0.008***	0.148	0.026***
Maragoli	-0.072	0.062	-0.188	0.032***	0.170	0.040***	0.117	0.010***	0.055	0.008***	0.135	0.026***
Yasawa	-0.069	0.039*	-0.043	0.046	-0.065	0.042	0.064	0.013***	-0.018	0.042	-0.189	0.040***
Shuar	-0.068	0.020***	-0.073	0.030**	-0.065	0.045	0.092	0.033***	0.089	0.008***	-0.037	0.026
Isanga	-0.063	0.045	-0.057	0.032*	-0.057	0.045	0.100	0.017***	0.040	0.031	0.048	0.026*
Dolgan/Nganasan	-0.047	0.032	-0.010	0.059	0.018	0.043	0.099	0.018***				
Samburu	-0.020	0.018	-0.088	0.029***	-0.069	0.039*	0.088	0.010***	0.029	0.008***	-0.042	0.026
Sursurunga	-0.013	0.047	0.073	0.038*	0.242	0.133**	-0.045	0.035	0.087	0.018***	-0.158	0.050***
Au	-0.013	0.018	0.000	0.029	0.070	0.039*	0.043	0.010***	0.042	0.008***	0.045	0.026*
Sanquianga	0.050	0.031	0.037	0.035	-0.007	0.046	0.000	0.031	0.147	0.016***	-0.012	0.043
Rural Missouri	0.053	0.018***	0.037	0.037	0.149	0.040***						
Significance of reg.	0.005%		0.005%		0.005%		0.005%		0.005%		0.005%	
Obs.	420		428		424		396		364		357	
R^2	0.100		0.228		0.284		0.159		0.093		0.327	

Note. $x^{\min}$ were left undefined for subjects rejecting offers of 0.5; 12 observations are lost as a result. $x^{\max}$ could not be defined for the Rural Missourians; 28 observations are lost as a result. x^{fine} were left undefined for subjects who fined every offer; 2 observations were lost as a result. Standard errors adjusted to account for non-independence within sessions. $* = 10\%$, $** = 5\%$, $*** = 1\%$ significance. Including session size as a control yields statistically indistinguishable results with respect to the significance of the society indicators. Session size enters only the x^{fine} regression significantly (10%) with a positive coefficient.

In stark contrast, the relationship of mean DG offers to UG maximum acceptable offers is well defined, negative, significant at the 1 percent level according to a naïve pairwise correlation across means, and in strong accordance with Prediction 2. Here, according to bootstrap tests of the form described above, the predicted relationship cannot be rejected for any society.

6.3. **DG and UG Offers.** If the society mean UG offers are plotted against society mean DG offers and the resulting scatter superimposed on the graph relating to Prediction 3 above, Figure 8 is returned.[15] The relationship between society mean DG and UG offers is positive, significant at the 0.1 percent level, and in accordance with Prediction 3. According to a bootstrap test of the form described above, the predicted relationship cannot be rejected for any society. Finally, an OLS regression of society mean UG offers on society mean DG offers returns a constant that is statistically indistinguishable from zero and a slope coefficient that is highly significant and statistically indistinguishable from one.

FIGURE 8. Predictions versus Data for Ultimatum Game Offers



The relationship between DG and UG offers can also be explored at the subject level as, in all but one society, the same subjects played as Player 1s in both the DG and the UG. Table 8 presents three subject-fixed-effects (within) regressions of offers made in the DG and UG. The dependent variable in each regression is the size of the offer made; the only explanatory variable is a dummy indicating that the offer was made in the UG rather than the DG. In Column 1, the analysis is conducted for the full sample of DG and UG offers.[16] In Columns 2 and 3, the sample is divided in accordance with Figure 5: in Column 2 the sample is restricted to DG and UG offers made by individuals offering 0.2 or more in the DG; and in Column 3

[15]To establish that there is sufficient cross-society variation in behaviour to support such an analysis, a subject-level regression taking UG offers as the dependent variable was added to the set of regressions described in Footnote 14 above. This regression was highly significant and is reported in Table 7.

[16]The offers made in Rural Missouri are excluded for the reason given in Footnote 3.

the sample is restricted to DG and UG offers made by individuals offering zero or 0.1 in the DG. The small, positive, significant coefficient on the UG indicator in Column 1 reveals that, on average, subjects offered more in the UG compared to the DG. The insignificance of the corresponding coefficient in Column 2 and the markedly larger, positive, and highly significant corresponding coefficient in Column 3 reveal that the average increase in offers between the DG and the UG is driven by increases at the far left of the distribution, i.e., by subjects who offered zero or 0.1 in the DG. Like the society-level analysis, this subject-level analysis both accords with Prediction 3 and explains why, in Figure 8, many of the data points appear marginally above and to the left of the predicted relationship.

Table 8. Regression Analysis of Offers in DG and UG

	1 All		2 If $x_{DG} > 0.1$		3 If $x_{DG} \leq 0.1$	
	Coeff.	s.e.	Coeff.	s.e.	Coeff.	s.e.
Constant	0.365	0.007***	0.420	0.007***	0.058	0.017***
UG	0.024	0.011**	-0.013	0.010	0.229	0.025***
Obs.	848		723		125	
R^2	0.013		0.001		0.444	

Note. All estimates relate to subject-fixed-effects (within) regressions for DG and UG offers only. Offer size is the dependent variable. UG = 1 if offer was made in Ultimatum Game. So, the constant reports the mean Dictator Game offer for supporting sample. $*$ = 10%, $**$ = 5%, and $***$ = 1% significance.

6.4. **DG Offers and TPG Fining Strategies.** If the society mean minimum unfined offers are plotted against society mean DG offers and the resulting scatter superimposed on the graph relating to Prediction 4 above, Figure 9 is returned.[17] The relationship between mean DG offers and TPG minimum unfined offers appears positive but is not quite significant at the 10 percent level (the p-value associated with the naïve pairwise correlation is 0.117). However, if the two highest data points in the graph (the Gusii and the Maragoli) are excluded, a positive relationship that is significant at the 5 percent level is found across the remaining eleven societies. This relationship appears to be below and to the right of the predicted line. However, bootstrap tests of the form described above indicate that the predicted relationship is rejected only for the Gusii, for whom the data point is above and to the left of the line.

6.5. **DG and TPG Offers.** If society mean TPG offers are plotted against society mean DG offers and the resulting scatters superimposed on the graph relating to Prediction 5,

[17]To establish that there is sufficient cross-society variation in behaviour to support such an analysis, a subject-level regression with TPG minimum unfined offers as dependent variable was added to the set of regressions described in Footnote 14 above. This regression was highly significant and is reported in Table 7.

Figure 9. Fining in the Third-Party Punishment Game

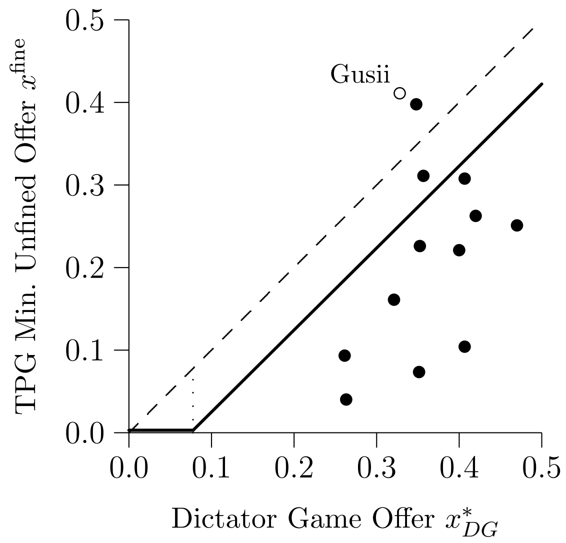
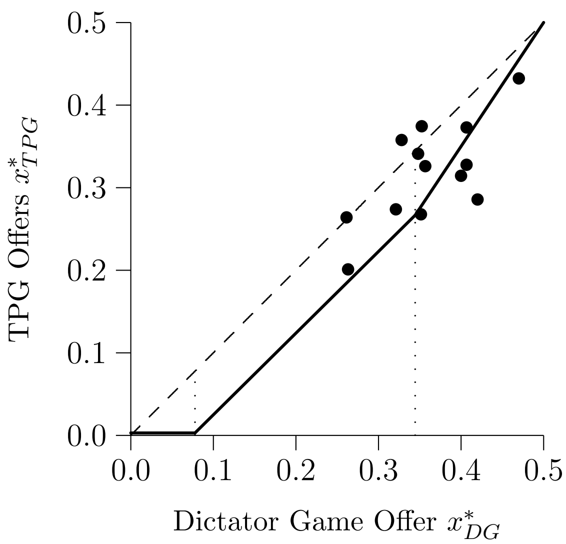


Figure 10 is returned.[18] The relationship between mean DG and TPG offers is positive and significant at the 1 percent level and, according to bootstrap tests of the form described above, the predicted relationship cannot be rejected for any society.

Figure 10. Offers in the Third-Party Punishment Game



Finally, while it is not possible to incorporate TPG offers into a subject-fixed-effects regression analysis, it is possible to conduct a pooled, cross-section regression analysis of all the offers made in all three games. Table 9 presents two such regressions. In Column 1, offers, pooled across all three games, are regressed on two variables, one indicating that the offer was made in the UG and the other indicating that the offer was made in the TPG. (Offers

[18]To establish that there is sufficient cross-society variation in behaviour to support such an analysis, a subject-level regression taking TPG offers as the dependent variable was added to the set of regressions described in Footnote 14 above. This regression was highly significant and is reported in Table 7.

Table 9. Regression Analysis of Offers in DG, UG, and TPG

	1		2	
	Coeff.	s.e.	Coeff.	s.e.
Constant	0.365	0.015***	0.374	0.022***
UG	0.025	0.013*	0.022	0.012*
TPG	-0.048	0.020**	-0.062	0.015***
Session size (÷10)			0.008	0.005
Hadza			-0.117	0.028***
Tsimane			-0.167	0.033***
Emory			-0.053	0.042
Gusii			-0.047	0.032
Maragoli			-0.080	0.036**
Yasawa			-0.038	0.034
Shuar			-0.029	0.031
Isanga			-0.023	0.025
Dolgan/Nganasan			0.002	0.042
Samburu			-0.059	0.033*
Sursurunga			0.042	0.024*
Au			-0.023	0.035
Sanquianga			0.080	0.025***
Rural Missouri			0.067	0.027**
Obs.	1212		1212	
R^2	0.026		0.130	

Note. Standard errors adjusted to account for non-independence within sessions; $*$ = 10%, $**$ = 5%, $***$ = 1% significance. Offer size is the dependent variable.

made in the DG are, once again, the basis for comparison.) Then, in Column 2, the number of subjects present at the session in which the offer was made and fourteen dummy variables indicating which society the subject making the offer came from (Accra is the basis for comparison) are included as additional explanatory variables. In both regressions, the standard errors relating to the estimated coefficients are adjusted to account for non-independence within sessions by clustering.

The UG indicator coefficients in both regressions are consistent with the subject-fixed-effects analysis. The TPG indicator coefficient is negative, two to three times larger, highly significant, and consistent with the prediction.[19]

Finally, like all of the regressions presented in Table 7, the regression in Column 2 of Table 9 provides evidence of significant variations in behaviour across societies. The Hadza, Tsimane, Gusii, and Samburu all offer significantly less than Accrans; the Sanquianga and Rural Missourians offer significantly more.[20]

[19]Clustering by individual subject or by society returns almost indistinguishable results. Within subject random-effect regressions return slightly smaller coefficients on the TPG game indicator: 0.038 and 0.057 in the models with and without session size and society indicators respectively. Tobit estimations that account for the truncation of offers at zero and one return slightly larger coefficients on the TPG game indicator: 0.043 and 0.066 in the models with and without session size and society indicators respectively.

[20]The society indicators are jointly significant at the 0.005 percent level. Out of the 92 possible pairwise comparisons of coefficients on society indicators, 42 indicate significant differences between societies at the 1

7. Departures from the Theory

The findings in the previous section indicate that, in general, the simple theoretical model presented above explains the experimental data very well. However, there are several noteworthy points of divergence: the incidence of fining in the TPG is too high to be explicable by error alone; minimum acceptable offers diverge significantly from the theoretical prediction in three societies (too high in one, the Gusii, and too low in two) and appear low in most; the minimum unfined offer is significantly higher than predicted in one society (the Gusii) but appears low in most; and the high UG offers among the Sursurunga, high TPG offers among the Maragoli, the rejection of offers of 0.5 in the UG among the Hadza and the Sursurunga, the correspondingly high incidences of rejection in those two societies, and the high incidence of rejection coupled with the reduction in offers between the DG and UG among the Maragoli are all causes for concern.

7.1. **The Incidence of Fining and Rejecting.** Prediction 1 states that TPG offers should never be fined in equilibrium. However, significant fining is seen in the data. Fining would occur in equilibrium if the cost of fining to Players 1 and 3 were lower. However, given the values used in the experiments and the utility function in (1), equilibrium fining should not be observed.

Equilibrium fining would also be predicted if players in different roles assigned and were assigned different weights w_{ij}, such that the utility function took the form

$$u_i' = x_i - \alpha \left[\sum_{j=1}^{n} w_{ij} \left(x_j - \bar{x} \right)^2 \right],$$

where $\sum_{j=1}^{n} w_{ij} = 1$. (The model presented in Section 4, arbitrarily, sets $w_{ij} = \frac{1}{n}$ for all i and j.) Now, if Player 3 places high weights on the inequality between Players 1 and 2 (and α is high enough so that fining is optimal even for large offers), while Player 1 places low weights on the inequality between Players 1 and 2 (and α is not too high, so that a fined zero offer yields higher utility than any unfined offer), fining would occur in equilibrium. For example, if Player 1 has (extreme) weights such that $w_{13} \approx 1$, and Player 3 has weights $w_{31} = w_{32} = \frac{1}{2}$, then $\alpha = 3$ is large enough to guarantee fines in equilibrium. However, if α is very large, Player 1 is too inequality averse for fining to remain an equilibrium.

The alternative utility function u_i' does not alter the prediction that Player 2 in the UG never rejects an equilibrium offer. The reason is that rejection in the UG results in zero payoffs for both players;[21] in the TPG, however, positive payoffs accrue even in the presence of a fine.

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percent level, an additional 6 indicate significant differences at the 5 percent level, and a further 6 indicate significant differences at the 10 percent level.

[21]An offer of $x = \frac{1}{2}$, followed by Player 2's acceptance, yields a payoff strictly greater than zero (in fact, $u_i' = \frac{1}{2}$) to both players regardless of the weights (or α). Therefore, in the subgame following such an offer Player 2 must, in equilibrium, accept. Such an offer is always available to Player 1, so it can never be subgame perfect for Player 1 to have an offer rejected, and thus receive zero (although it may be Nash).

An alternative, and less ad hoc, approach would be to model uncertainty explicitly to take account of apparent variations in α within societies. For instance, and returning to the utility function in (1), assume that each player's α is drawn from some (society-specific) distribution. Such a model would generate equilibria in which there were non-zero probabilities of fining in the TPG and of rejection in the UG.

7.2. **Minimum Acceptable and Minimum Unfined Offers.** In the UG, minimum acceptable offers are significantly lower than predicted in two societies and appear lower than predicted in most others; minimum unfined offers in the TPG also appear low. Further, the society mean minimum acceptable offers are highly correlated with society mean minimum unfined offers, suggesting that whatever mechanism is driving the former away from the prediction is doing the same to the latter.[22] Given the application of the strategy method in both cases, the mechanism cannot be related to uncertainty.[23] A preference for efficiency could explain the lower-than-predicted rejecting and fining. However, it cannot explain the significant and notable exception: among the Gusii both the mean minimum acceptable offer and the mean minimum unfined offer are significantly greater than predicted. It seems unlikely that the Gusii have a preference for inefficiency! An alternative explanation is that a preference relating to acts of vengeance is at work, with most societies sharing a preference against vengeance and the Gusii displaying a preference in favour of vengeance.[24]

7.3. **The Sursurunga, the Hadza, and the Maragoli.** Among the Sursurunga, eight people rejected UG offers of 0.5. The strategies chosen by two displayed multiple inconsistencies, suggesting that they did not understand the task. The remaining six indicated minimum acceptable offers in excess of 0.5, with four indicating a minimum acceptable offer of 1.0 and stating after the experiment that they wanted "all or nothing". These strategies and post-play statements do not accord with the theoretical model presented above. However, they are consistent with the subjects' reputations within their community as difficult individuals who, if crossed, may retaliate with sorcery. Further, they are consistent with the subjects treating the experiment as an opportunity to bolster reputations as hard and ruthless bargainers and, in turn, with costly signalling (Spence, 1973, 1974) and, possibly, the "madman" theory attributed to Schelling (1960). That play was anonymous weakens this argument, although players were always at liberty to tell others what they had done in the game afterwards and, in this case, their stories may have been corroborated by Player 1s who offered 0.5 and had those offers rejected.[25]

[22]Note also that the mechanism does not appear to affect maximum acceptable offers, possibly because these relate to offer levels that the Player 2s do not expect to see.

[23]Using the first-round data, Henrich et. al. (2005) explored uncertainty's role in determining UG offers.

[24]A preference against vengeance is known to exist among the Yasawa. However, at the current time, there is no data relating to the other societies.

[25]Reputation maintenance offers a complementary explanation for some of the features of the data that are consistent with the theory. After participating in the experiments, several Shuar subjects indicated that they had acted in a manner that, they hoped, would convey an image of the Shuar as fair-minded people.

Among the Hadza, five people rejected UG offers of 0.5. Two of these accepted all offers greater than 0.5, suggesting that the rejection of 0.5 may have been a mistake. However, the strategies for the remaining three are monotonic and indicate minimum acceptable offers of 0.7 in the case of two and 0.9 in the case of one. Though not as marked as the four Sursurungan strategies described above, these Hadza strategies may also be a result of costly signalling. The Hadza are known to be hard bargainers both among themselves when sharing meat from hunted prey and with outsiders.

The high incidence of rejection in the UG among the Maragoli is not owing to rejections of offers of 0.5. Rather, it is the result of a mismatch between UG offers and rejection strategies; low offers are often rejected, but this appears not to have been anticipated by the Player 1s, who often make low offers. To some extent this reflects an unpredicted fall in offers between the DG and the UG. While this fall is not sufficient to push the society means off the predicted relationship or to show up in the subject-fixed-effects analysis of DG and UG offers pooled across all sites, a subject-fixed-effects analysis of DG and UG offers among the Maragoli indicates that the fall in offers between the two games is significant at the 10 percent level. Further analysis indicates that the Maragoli who reduced their offers between the two games were relatively poor and had made relatively high offers in the DG. However, if the reductions in offers were adjustments aimed at compensating for overly generous DG offers, they were badly judged: most of these Player 1s earned nothing from the UG as a result of their actions. The researcher who conducted the experiments with the Maragoli reports that the sessions were very long and that, by the time the UG was played, some subjects were angry. Maybe this anger led to impaired judgement.

Another factor contributing to the Marigoli's high rejection incidence in the UG may be the recent shocks they have suffered: AIDS has taken a heavy toll leaving almost 30 percent of the sampled population widowed and the year preceding the experiments was marked by a severe drought. It is quite plausible that, therefore, this society is in behavioural disequilibrium.

7.4. **High Offers.** Given the care taken to ensure that the subjects understood the decisions they were being asked to make, the incidence of offers greater than 0.5 is high. However, like the high minimum acceptable offers described above, these too may be explicable with reference to a meta-game. It could be that these individuals were choosing to make high offers so that, after the experiments, they could describe their actions and thereby boost their reputations as generous individuals.

8. Conclusion

This paper first presented and then analysed a dataset relating to three bargaining games played under controlled conditions in fifteen societies. The behavioural data generated by these games varied markedly across societies. The focus of the analysis was to investigate whether and to what extent these variations could be explained by differences along a single dimension, namely the value placed on equality. Combining a simple, well-behaved utility function containing a single preference parameter capturing the notion of inequality aversion with that of subgame perfection, several predictions were generated. In general, the data accorded with these predictions thereby providing support for the overarching hypothesis that, within the context of the DG, UG, and TPG, inequality aversion is the principle motivating factor and variations in behaviour across societies and across individuals within societies do, in large part, result from differences in the value placed upon equality.

Despite the overall success of the model, it failed in a number of telling regards. First, a preference other than inequality aversion appears to have a bearing on the rejection and fining of inequitable behaviour and, as both a preference for efficiency and an aversion to uncertainty can be ruled out, a preference for or against vengeful acts is the most likely candidate. Second, in two societies some of the experimental subjects appear to have used the games as an opportunity to signal, at a cost to themselves and others, their bargaining prowess. Finally, in almost all societies the incidence of fining in the TPG is significantly greater than zero, indicating that a model in which players are uncertain about the preferences of their playing partners may do better than the one presented here.

In conclusion, while the data repeatedly indicate that the value placed on equality varies widely across societies, it appears to be greater than zero in all. At least within the context of simple bargaining games, homo sapiens might reasonably be described as homo æqualis.

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