Social decisions under risk. Evidence from the Probabilistic Dictator Game.

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Abstract: This paper reports results of a 'probabilistic dictator game' experiment in which subjects had to allocate chances to win a prize between themselves and a dummy player. We have manipulated (within subjects) two aspects of the game: the relative values of the prizes (being equal for the two players, higher for the dictator or higher for the dummy) and the nature of the lottery determining the earnings: we used independent draws for the two players ('noncompetitive' condition) or a single draw ('competitive' condition). We have also asked for decisions in a standard, non-probabilistic, setting. Main results can be summarized as follows: First, a substantial fraction of subjects do share chances to win, also in the competitive treatments, thus showing concern for the other player that cannot be explained by outcome-based inequality aversion or quasi-maximin models. Second, this concern hardly ever leads to equalizing expected payoffs. Third, subjects appear to be somewhat efficiency-oriented, as they share more when partner's prize is relatively high.

Keywords: social preference, other-regarding utility, risk attitude, inequality aversion, social concern

JEL classification: A13, B49, C62, C65, D63.

1 Introduction

Many everyday situations involve choices between options with uncertain consequences for the decision maker and some other individuals. A particularly simple example is a decision whether or not to share chances to obtain some reward. A student may help a less-able friend before an exam or an employee may–or may not–play fair against a competitor, applying for the same position in the firm. In both cases, the active agent may choose to sacrifice some chances of success, passing an exam or being promoted resp., to the benefit of the other agent due to some moral or social consideration. The subtle difference between these two examples is that while in the first case equality of outcomes may be obtained, *e.g.* both students pass, in the other one only *chances* may be equal, but eventually only one of the candidates will enjoy the promotion. Still, intuition and anecdotal evidence suggests that at least some individuals may consider the notion of fair chances sufficiently compelling to offer some chance to competitors in such a case.

In these examples, non-selfish behavior can hardly be explained by models incorporating social concerns defined on outcomes only. This is particularly evident in the second example, where the final allocation is necessarily extremely *un*equal anyhow. Several of these models emerged in the past decades. Being able to account for non-egoistic behaviors observed in experimental studies, they now enjoy substantial popularity. The main difference with respect to the standard assumption on economic agents is that these models assume that individuals' preferences take into account others' situations in some way. One class of models is based on aversion to inequality of payoffs (Fehr and Schmidt 1999, Bolton and Ockenfels 2000). The basic idea is that subjects experience disutility from having outcomes different from others' – both being behind ("envy") and ahead ("guilt" or "shame"). Using a different notion of social concerns, a more recent model was developed by Charness and Rabin (2002) on the idea of a maximization of both total payoffs (hereafter social utilitarianism) and of the payoff of the worst agents (maximin). The question to know which model captures subjects' preferences over allocations more accurately is still open and under intense scrutiny (Engelmann and Strobel 2004, Fehr, Naef, and Schmidt 2006, Bolton and Ockenfels. 2006, Engelmann and Strobel 2006).

The important point about these models is that they restrict the definition of social concerns to payoffs or consequences. However, intuition suggests that fairness goes beyond equality of outcomes: Equality of chances may matter at least as much as equality of outcomes. In other words, people may want to share chances to win some prize or expected outcomes fairly, as they appear to be willing to share actual outcomes fairly. However, the literature, both at the empirical and theoretical level, has very little to say about how social concerns operate in the presence of risk. This contrasts strongly with the overwhelming evidence suggesting concerns for 'procedural fairness' in various realms: Many institutions use random procedures to insure fairness (Broome 1984); Actual court decisions provide some justification for such a practice, as in the well-known case US vs. Holms[1]; The concept of *equality of opportunities* is widespread across political and philosophical literature (Rawls 1971); And last but not least, it is a common habit to draw lots when non-divisible goods or costs are to be shared, as in the Machina's mom example (1989). These examples suggest that social concerns cannot be assessed only by taking into account consequences. Rather, their definition should consider the distribution of risk, *e.g.* by comparing expected payoffs.

Situations where such concerns may play a role are abundant in economic realms: Any resource increasing the likelihood to obtain some goods that is shared provides a relevant case for such social preferences under risk. These include situations such as firms choosing not to take unfair advantage when competing for a contract, traders in financial markets freely exchanging information, fair-play in sports, sharing of organs by living donors and many other. In the context of strategic interaction, it may help understand why some inefficient mixed-strategy Nash equilibria arise instead of pure efficient ones, for instance in the Battle of the Sexes (Cooper, DeJong, Forsythe, and Ross 1989). In the domain of public economics, it explains why redistribution policies enjoy weaker support in countries where citizens believe to a greater extent in the existence of equality of opportunity, *e.g* US vs Europe (Alesina

[1]Crew members were prosecuted for excluding themselves when drawing lots to decide who should leave an overcrowded and leaking lifeboat.

and Angeletos 2005).

Yet, except for a few path-breaking studies (Bolton, Brandts, and Ockenfels 2005, Brennan, Gueth, Gonzalez, and Levati forthcoming, Gueth, Levati, and Ploner forthcoming, Karni, Salmon, and Sopher 2008), very little evidence is readily available on how risks and outcomes interact in the context of fairness or social preferences. The purpose of this paper is to explore experimentally how subjects behave in a simple distributive decision situation, where choices are likely to be affected by attitudes toward risks and others. A particularly relevant question seems to be the extent to which choices could be explained by social concerns on outcomes only. Put differently, we want to know how strong social concerns in terms of *chances* could be. Do subjects equalize expected payoffs or chances to win some prize, or are they merely inequality averse with regards to consequences? When outcomes are necessarily asymmetric, are subjects willing to use risk allocation to counterbalance payoff inequality? Related issues that were also targeted include the importance of risk attitude and whether the situation is "competitive", *i.e.* whether participants compete for the same reward or independent rewards are available.

These questions are addressed through a series of simple decision tasks where subjects are asked to share 'tokens' which may represent monetary units or probabilities to win some prize. The results show that social concerns are indeed affected by risk involved. More specifically, a substantial fraction of subjects chooses non-selfishly when given an option to share chances to win mutually-exclusive rewards. However, choices in this condition are somewhat less generous than in case of sharing money, thus indicating that both aversion to inequality of outcomes and aversion to inequality of opportunities operate, the former being perhaps less potent. The data also suggests to extend current models by taking into account chances to see some consequence occurring, since all of them seem to wrongly predict subjects' behavior in some of the treatments at least. We also find little evidence of willingness to *equalize* expected or actual payoffs. Rather, subjects think it fair to give 'something' to a less-fortunate opponent. Finally, our subjects seem to be rather efficiency- than equality-oriented, as they share more when each token is worth more to the partner than to themselves.

The remainder of the paper is organized as follows: in Section 2 recalls the existing experimental studies and their findings; Section 3 describes the design and procedures, Section 4 establishes the predictions of various models of other-regarding preferences, Section 5 exposes the most important findings and eventually the last section concludes and suggests possibilities for further research.

2 Previous Experimental Studies

Despite its major implications, only a few studies have addressed the issue of reaction to inequality in the context of risk in an experimental way. These include Bolton, Brandts, and Ockenfels (2005), Karni, Salmon, and Sopher (2008) Brennan, Gueth, Gonzalez, and Levati (forthcoming) and Gueth, Levati, and Ploner (forthcoming).[2]

The first paper brings about evidence on other-regarding preference in the presence of risk, as subjects played Ultimatum Game with chances to win some prize. However, its use of interactive context makes it hard to disentangle preferences on outcomes and procedures *per se* from reciprocity and strategizing. Nevertheless, it suggests that subjects do consider chances to win some amount as equivalent to some certain monetary rewards in some contexts.

[2]We do not consider here some experiments that used lottery tickets as a convenient way to reward subjects and hence have *de facto* tackled the issue of social preference under risk, yet had quite differrent goals and methods, e.g. involved deception or very low stakes. These include Dawes and Fowler (2006) who investigated political participation and altruism, Handgraafa, van Dijk, Wilke, Vermunt (2004), Brown, W. M., and C. Moore (2002) who considered effects of smileys on behavior in games and classical experiments by Malouf and Roth (1979) and Roth, Murninghan and Schoumaker (1988) on sequential bargaining over lottery ickets. The general picture seems to be that replacing money with lottery tickets makes little difference, though this observation has to be treated with great care, as these studies do not offer suitable control treatments.

The second study directly tests Karni and Safra's (2002) model and thus addresses questions only tangential to our purpose. Indeed, the authors focus on whether an agent may want to give up some of its payoff to achieve procedural fairness between two other agents: The question of the interaction of own payoffs with fairness is not primarily tackled. Furthermore, they restrict attention to the case of a non-divisible good to share, and some of their results are only based on hypothetical, *i.e.* non-incentivized, questions. Besides, we tend to think it is instructive to start with the simplest, two-person case. By and large, Karni, Salmon, and Sopher (2008) find that individuals are willing to sacrifice (slight) chances to win in order to restore equality of chances for the other two players.

The third and fourth studies are closely related and seek to establish whether subjects care about the amount of risk assumed by another individual. To this end, they elicit willingness to pay or willingness to accept of social lotteries using the Becker-DeGroot-Marschak procedure. Their main findings is that although some subjects care about the allocation of expected payoffs, they do not seem to go about risk to self and others in the same way. More specifically, they are willing to pay to reduce variance in own but not others' payoffs. Yet, as authors point out themselves, the preference elicitation method used may be cognitively demanding for subjects, who may as a result have focused on a simple criterion such as maximization of own payoffs. In addition to this possible explanation, the design used by the two studies asks the subjects to compare a monetary amount for sure only for the decision maker with risky prospects for another subject: It might be that the effect in this case is too small to reach the conventional significance levels, given that on average certain outcomes are preferred to risky ones and own payoffs are preferred to others' and that the two effects combine in this case.

As a conclusion, it seems that some, albeit fragmentary, evidence exists that subject may take into account distribution of risks when socially-oriented. Yet none of these studies directly tackles the question how chances to obtain some prize are dealt with when to be allocated in the most basic case, among two subjects. They also offer little data on how willingness to share differ between probabilistic and deterministic context and how relative size of the pie matters. We think that these important issues deserve attention.

3 Design, procedures and some methodological issues

As the focus of the study is on social preferences under risk, we chose a very simple design, that rules out phenomena such as reciprocity or signaling of intentions. It thus involved one-time distributive decisions in a series of (generalized) 'Dictator Games' (Bolton, Zwick, and Katok 1998), hereafter DG. This method allows for comparison with the numerous experiments on allocation tasks run with monetary amounts (Engelmann and Strobel 2007). While the DG design has its important weaknesses, (Bardsley forthcoming) it is natural and very simple to understand for the subjects.

At the beginning of the experiment, we have assigned each subject to the role of player A ('dictator') or player B ('dummy'). This was fixed through the experiment, to prevent subjects from justifying selfish behavior on the grounds that the 'victim' will have a chance to be dictator herself in the following round. For the same reason we decided not to use the strategy method, favored in many related experiments (Andreoni and Miller 2002, Gueth, Levati, and Ploner forthcoming). Further, we did not want our subjects to perceive the allocation of roles as just random, as this, again could affect the perceived *ex ante* fairness of the situation. On the other hand, relying on some criterion possibly interpreted as legitimate by subjects (*e.g.* score at a previous task, 'first come, first served' procedure) could lead to some entitlement effect (Gaechter and Riedl 2005). Eventually, using some 'obviously unfair' criterion (*e.g.* racial) would be disputable from an ethical viewpoint and could lead to a strong emotional reaction thus overshadowing whatever distributional preferences the subjects could have in the first place.

We have thus decided to base the role assignment on arrival time but not in a monotonic way,[3] and subject were not led to believe that the latter was the case.

In each round, each dictator was matched to a new dummy and had to distribute 10 'tokens' between the two of them. Exactly what each token represented varied between the games. More precisely, the allocation tasks faced by subjects differed on two dimensions. First, we manipulated the 'prizes', that is, the maximum amounts that each player could earn in the given round. The prizes, in euro, for the dictator and dummy were $(10; 30)$, $(20; 20)$ or $(30; 10)$ respectively. In other words, next to the typical symmetric case, we considered an asymmetric dictator-favoring distribution of prizes and a asymmetric dummy-favoring one.

The second, more fundamental, dimension is the type of the game. In the Deterministic condition each token would simply correspond to one tenth of the prize, such that keeping all the tokens meant winning full prize. For example, if prizes were $(30; 10)$, keeping 7 tokens and passing 3 to the other player would result in earnings for the dictator and dummy being equal to 21 and 3 euro respectively.[4] In two other conditions, tokens would represent a probabilistic analogon of a fraction of the prize: In Probabilistic Competitive condition each token stood for a 10% chance of winning the prize, with the events of winning for both players being mutually exclusive. For example, with prizes $(30; 10)$ and the chosen distribution of tokens $(7; 3)$ as above, a die would be rolled: if the outcome was in $\{1, 2, ..., 7\}$, A would win 30 euro and B nothing; otherwise B would win 10 euro and A nothing. In the probabilistic Noncompetitve condition each token would still represent a 10% chance of winning own prize, yet A's and B's chances would be independent. With numbers given above, two dice will be rolled, one giving A a 70% chance of winning his prize and another giving B hers with a 30% chance.

[3]Precisely, odd-numbered subjects took the roles of dictators while even-numbered ones played dummies.

[4]It is very easy to note that a symmetric deterministic DG is the 'classic' DG familiar from many older papers.

The combination of both dimensions makes nine treatments possible, which are summarized in table 1:

	(10;30)	(20;20)	(30;10)
Certain Outcome	Deterministic-10	Deterministic-20	Deterministic-30
Non-Competitive Lottery	Noncompetitive-10	Noncompetitive-20	Noncompetitive-30
Competitive Lottery	Competitive-10	Competitive-20	Competitive-30

Table 1: *Nine Treatments*

In order to correlate behavior in different situations and increase statistical power for treatment comparisons, we implemented a within-subject design in the same spirit as Andreoni and Miller (2002): Our design can be seen as an adaptation of theirs when two probabilistic dimensions (Competitive and Noncompetitive) are added. Every subject played all nine games, grouped in three blocks: Deterministic, Competitive and Noncompetitive. Relevant instructions were distributed at the beginning of each block, followed by control questions. This organization of the experiment was implemented in order to insure the subjects were not confused about specific payment schemes. Every erroroneus answer to a control question was recorded and had to be corrected by the participant in question in order to proceed. The order of the blocks was different in different sessions and the order of particular rounds, *i.e.* with different prizes within each block was randomly manipulated at individual level. While dictators were busy with their decisions, the dummies were asked completely analogous, yet hypothetical questions.[5] At the end, it was announced which of the nine rounds would be played for real and the relevant decisions of the dictators were implemented, with one or two 10-sided dice being rolled publicly whenever appropriate.

After this part, a series of three individual decisions under risk were run, in order to establish individual attitudes towards risk. We used the interactive Multiple Price List design (Andersen, Harrsion, Lau, and Rutstrom 2006), to

[5]Similar procedure was used i.a. by karnietal2008. On the one hand it provides some additional, yet un-incentivized data at no additional cost and on the other makes it more difficult for the subjects to identify the types.

get certainty equivalent for 10, 50 and 90 percent chances to get 20 euro, the average stake level considered in the main task. Only one third of subjects were randomly picked for payment in this second part of the experiment, and if chosen, subjects were only paid for one of the tasks, once again randomly determined. Subjects were of course explicitly told so, and this particular payment scheme was implemented in order to be comparable with the decisions made in the first stage, where only one out of nine decisions were actually paid. We speculated that displayed risk attitude would correlate with the dictator decisions. In particular, subjects evaluating a 90 percent chance for 20 euro at much less than 20 euro (certainty effect) were expected to be more likely to keep all the tokens. Finally, subjects were asked to rate their satisfaction from own decisions and obtained outcomes and describe what they thought a typical subject did and (from the viewpoint of fairness) should do. At the end of the experiment a personal data questionnaire was distributed and subjects were paid their earnings in private.

The experiments were run in October and December 2007 in the laboratory of the Center for Research in Experimental Economics and Political Decision Making (CREED) in Amsterdam. The experiment was programmed using the z-Tree software (Fischbacher 2007). In total 128 subjects, mostly undergraduate students at the University of Amsterdam, participated. Average earnings for an experiment lasting from 70 to 100 minutes equaled about 22 euro, including a 7.50 euro show-up fee.

4 Theoretical predictions

The standard prediction–once the assumption that subjects are selfish is made–is that all players should keep all the tokens to themselves, regardless of the relative prize, the payment procedure or even their own attitude towards risk. Concerning other-regarding preferences, few models available in the literature, with a notable exception of Trautmann (2006), seem immediately suitable for generating predictions for our experiment. To use current models of social preferences, one needs to make the natural assumption that preferences are represented by the product of the social utility on outcomes and the corresponding probabilities. Charness and Rabin (2002) for instance implicitly endorse this view in their definition of a social-welfare equilibrium and the corresponding mixed strategies, p. 853.[6] This apparently innocuous and natural generalization leads to some clear-cut predictions.

4.1 Pure inequality aversion models

As a generalization of inequality aversion models, we consider a model defined in Appendix, *à la* Fehr and Schmidt (1999) or Bolton and Ockenfels (2000). In a two-person game, it generalizes both models and give, especially compared to the former (linear) model, some flexibility to account for the data. This is possible because the measurement of inequality is equivalent in both models when only two agents are concerned. This procedure has also the critical advantage that predictions do not crucially depend on parameters. We will refer to this generalized model as pure inequality aversion model. As it is well known, such inequality aversion models predict for the Deterministic case that choices are between a payoff-equalizing division and a selfish one: the admissible range is thus (2,10) for the dictator-favoring asymmetric case, (5,10) for the symmetric game and (7,10) for the dummy-favoring. In the general case, it is not possible to say more, the results depending on the shape of the utility component based on inequality aversion.

In the case of a symmetric probabilistic DG, some interesting features emerge. First, when the lottery is competitive, it is straightforward that the dictator should choose to keep all the tokens. Indeed, complete inequality will occur no matter who ends up winning the money. Therefore, even if there is no self-serving bias in the evaluation of fairness, self-interest will make agents maximize the probability that they win rather than the opponent. This is also independent from any possible non-linear probability weighting. The same is true for the dummy-favorable case (Competitive10). In general,

[6]They also defend this point of view in a former version of their QJE paper, see footnote 46.

this also happens for the dictator-favorable treatment (Competitive30): Very strong inequality aversion may lead to non-selfish choices. It is possible that $u(30, 0) < u(0, 10)$ due to inequality aversion and hence it may be the case that such subjects *give* all the tokens to the other player. Of course, this also implies that some (very few) subjects can be indifferent between $(30, 0)$ and $(0, 10)$, and keep any number of tokens.

For two independent gambles–Noncompetitive treatment–the situation is less straightforward. In the symmetric case, the possibility to end up in the worst possible outcome, unfair and disadvantageous, $(0; 20)$ may be partly counterbalanced by the possibility to get the preferred outcome $(20; 20)$. It can hence be the case that the dictator does not keep all the tokens. Technically, if the utility function is normalized so that $u(0; 0) = 0$, the requirement is that $u(20; 20) > 2u(20; 0)$[7]. It means that the subject must be inequality averse, and that this inequality aversion should be strong enough to imply that in the Deterministic20 treatment the decision-maker has not kept all the tokens (see Appendix for details). Regarding situations with asymmetrical prizes, the prediction is similar. In the $(30; 10)$ case, the number of token given is positive if $u(30, 10) > 2u(30, 0)$, which obviously implies an even greater inequality aversion than int the previous case. And when applying, this should not imply that more than half the tokens are given. The range of possibilities for the $(10, 30)$ is equivalent to the one for $(20; 20)$.

4.2 Quasi-maximin models

Previous studies (Andreoni and Miller 2002; Charness and Rabin 2002) tends to show that subjects exhibit a strong heterogeneity concerning social preferences/social concerns, and that utilitarian motives have to be taken into account as for instance in the model by Charness and Rabin (2002). These authors have proposed a simple model[8] based on the idea that the apparent inequality aversion was in fact the willingness to maximize the minimal

[7]See Appendix for details. It is also assumed that $u(20; 0) > u(0; 0)$ which is not as such implied by the model.

[8]For obvious reasons we disregard here the reciprocity part of their model.

payoff, *i.e.* the payoff of the worse off agent. The model also includes a total welfare term in the equation (see Appendix for details). Here again, the model is linear, but a natural generalization is possible. It is straightforward that in the standard DG, Deterministic20, the ratio x of the number of tokens kept over the total number of tokens should lie in $[\frac{1}{2}, 1]$. In the Dummy-favorable case any allocation of tokens is allowed, 0 chosen by a subject only interested in maximizing the total payoff, 1 by a purely selfish subject. For Deterministic30, the appropriate range is $[\frac{1}{4}, 1]$: $\frac{1}{4}$ corresponds to the maximization of the minimal payoff, and 1 to either the selfish outcomes or the 'utilitarian' one. When the model is extended to risky outcomes on the basis of expected utility, it, not surprisingly, predicts that $p = 1$ in (almost) all competitive treatments (see Appendix for the details).

In the case of the symmetric non-competitive treatment, things are less clear-cut. For some range of parameters, the number of tokens kept can be different from 10: as in the case of pure inequality based model, it also requires that $u(20; 20) > 2u(20; 0)$. This corresponds to very strong social concerns: Such a case never holds for the specific linear model of Rabin and Charness for example. The requirements in the $(30, 10)$ case are even more demanding. On the contrary, it is possible with some range of parameters that the number of tokens given Noncompetitive10 reaches 10, when the subjects is only concerned about the total payoff. Yet, it seems fair to say that although not impossible such interior choices should be at best occasional.

4.3 Probabilistic inequality aversion models

The model by Trautmann (2006) is the most tractable mode taking into account risk and social preferences. Being an expected-payoff generalizaion of the model by Fehr-Schmidt it makes identical prediction for all game types: it proposes that subjects either keep all the tokens or equalize expected payoffs. Again, a simple generalization to non linear functional forms allows for intermediate choices as well, identical to the predictions of the pure inequality aversion model for the deterministic case.

4.4 Some extensions and caveats

Using generalized models of expected utility instead of mere expected utility, for instance by applying a probability transformation function to probabilities, does not change much of the predictions, at least in the Competitive case. In particular corner solutions (typically $p = 1$) still hold. In other words, most of these predictions are not based on the assumption of a linear treatment of probabilities. They depend much more critically on the fact that probability distributions are not taken into account in the terms summarizing social concerns, be it inequality aversion or quasi-maximin.

Likewise, most of these predictions do not rely on specific parameter or functional forms of the models–and that may explain their vagueness in some cases. Predictions in the case of inequality aversion are based on the mere fact that

$$u(20; 20) > u(20; 0) > u(0; 0) > u(0; 20)$$

and in the case of quasi-maximin on the following ranking

$$u(20; 20) > u(20; 0) > u(0; 20) > u(0; 0)$$

This simply means that, if the models appear to predict wrongly in some of our treatments, it cannot be argued that it is because of a specific form of the model chosen. In particular, no generalization of the corresponding models, as long as social concerns depend only on consequence, are about to solve the problem.

For a handy reference, we summarize all these predictions in Table 2, with fractions of tokens kept (figures in parenthesis represent possible yet implausible individual choices):

Treatment/Predictions	Inequality-Based	Trautmann	Quasi-Maximin	'Selfish'
Deterministic-20	$[\frac{1}{2}, 1]$	$\{\frac{1}{2}, 1\}$	$[\frac{1}{2}, 1]$	1
Deterministic-10	$[\frac{3}{4}, 1]$	$\{\frac{3}{4}, 1\}$	$[0, 1]$	1
Deterministic-30	$[\frac{1}{4}, 1]$	$\{\frac{1}{4}, 1\}$	$[\frac{1}{4}, 1]$	1
NonCompetitive-20	$[\frac{1}{2}, 1]$	$\{\frac{1}{2}, 1\}$	$[\frac{1}{2}, 1]$	1
NonCompetitive-10	$[\frac{1}{2}, 1]$	$\{\frac{3}{4}, 1\}$	$[0, 1]$	1
NonCompetitive-30	$[0, 1]$	$\{\frac{1}{4}, 1\}$	$[0, 1]$	1
Competitive-20	1	$\{\frac{1}{2}, 1\}$	1 ($[0, 1]$)	1
Competitive-10	1	$\{\frac{3}{4}, 1\}$	1 ($[0, 1]$,0)	1
Competitive-30	1 (0, $[0, 1]$)	$\{\frac{1}{4}, 1\}$	1	1

Table 2: *Predictions*

5 Results

The results generally indicate the limitation of outcome-based models that cannot account for some of the findings. However, we find challenges for the probabilistic inequality aversion approach as well.

To begin our analysis we first note that, while subjects were allowed to distribute less than 10 tokens, they virtually never chose to do so: this happened in just 5 out of 1152 possible cases.[9] In what follows we thus focus on the variable 'self', meaning the number of tokens kept by the decision maker, be it in the real or hypothetical case. Figure 1 gives an overview of frequencies of dictators' choices for each of the nine treatments (differing in terms of type of the game and prize for the decision-maker) and Figure 2 analogous decisions made hypothetically by B-players (dummies). Tables 3 and 4 report means of this variable in particular treatments. Several observations may be readily made.

Starting with decisions made 'for real' we note that, first, a large fraction of choices in each treatment entails keeping all the tokens to oneself. Actually, keeping 10 tokens is always the median choice and may be chosen by as much as three-quarters of individuals, as in treatments Competitive-30 and

[9]Which, of course, should not be very surprising.

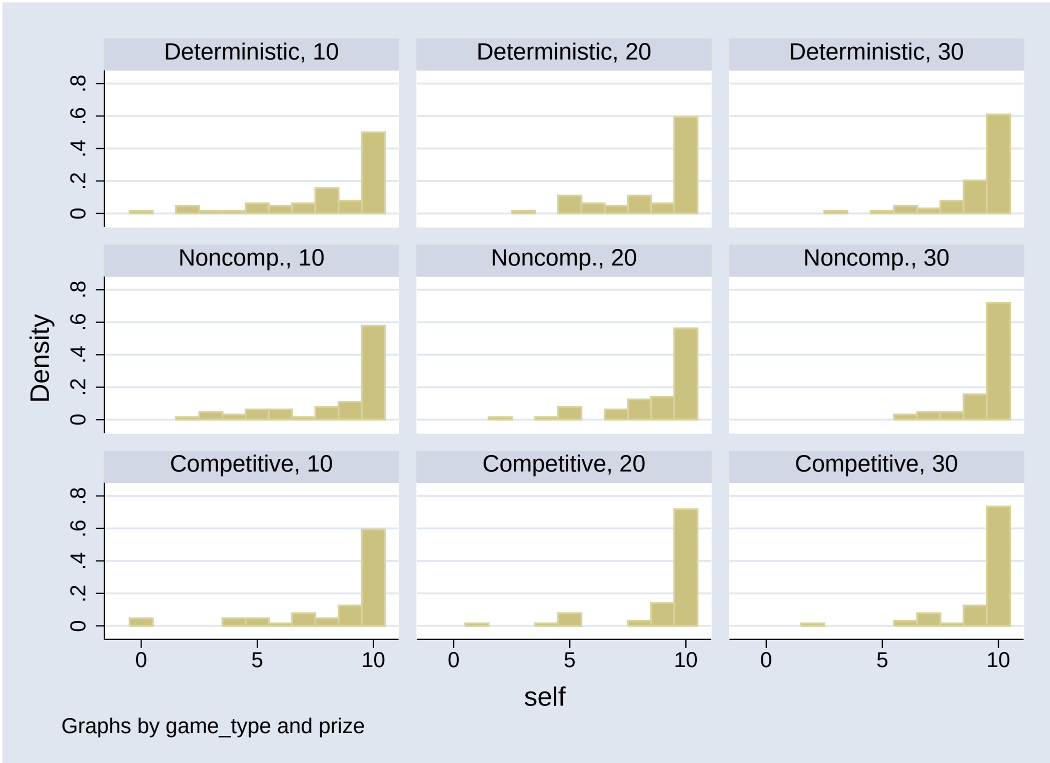

Figure 1: *Frequencies of dictators' choices in all treatments*

Game type / Prizes	10	20	30
Deterministic	8.19	8.67	9.17
NonCompetitive	8.48	8.81	9.48
Competitive	8.50	9.17	9.36

Table 3: *Dictators' means*

Game type / Prizes	10	20	30
Deterministic	7.45	7.13	7.28
NonCompetitive	7.09	7.67	8.11
Competitive	7.14	7.48	8.30

Table 4: *Dummies' means*

Noncompetitive-30. Overall, mean number of tokens kept is 8.87. However, non-selfish choices cannot be regarded simply as 'mistakes'. First, there are too many of them. Second, the most 'typical' mistake to be expected seems

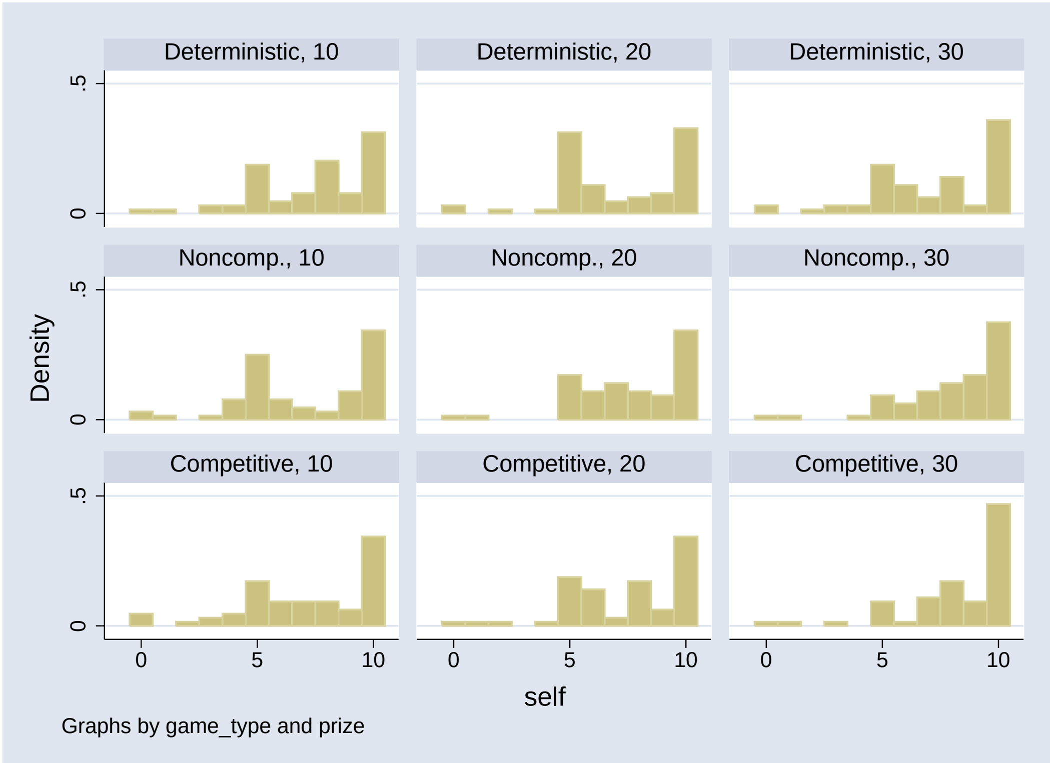

Figure 2: *Frequencies of dummies' hypothetical choices in all treatments*

to be keeping 0 tokens and giving 10 away, which happened utmost rarely and mostly when own prize was 10, which could thus be explained by some concern for efficiency. Third, another kind of mistake, distributing less than 10 tokens in total, was extremely rare, as mentioned before.

Clustering subjects in two categories depending on all of their nine choices (using k-means clustering procedures), we find that 42 dictators were almost always selfish (they almost always chose to keep all the tokens) and 22 were not. The fraction of 'egoistic' is a bit higher than is typically observed (around two thirds, rather than one half), which could be due to our sample, consisting chiefly of students of economics and econometrics with a lot of lab experience.[10]

[10] A Wilcoxon test comparing the two clustered populations in terms of number of previous experiments is highly significative ($p = 0.0028$) in this regard.

The non-selfish choices are distributed quite evenly between 5 and 9. The 'classic' Dictator Game case (Deterministic-20) seems to be the only one in which sharing tokens equally (5-5) appears to be somewhat prominent as in previous studies, though it was actually chosen only by 11 % of subjects. Moreover, we do not see a strong tendency to equalize earnings or expected earnings in asymmetric treatments: Apart from the standard DG with 20 euro, there is only a (limited) peak at the equalizing choice in Deterministic10.

Turning now to the hypothetical choices made by the 'dummies', we see a quite different picture. Their allocations decisions were much less selfish. While 10 is still the mode in every treatment, it is never median. Overall mean number of tokens kept is down 1.3 from the dictators' case or 7.5. Similar differences are apparent for all treatments. For example, in the 'classic' Deterministic-20 treatment, means of tokens kept drop from 8.67 to 7.12. A Wilcoxon rank-sum test indicates that this difference is strongly significant statistically ($p < .001$). The same can be said of (nearly) all treatments at 1 % level except for Deterministic-10, where the difference is not s.s. at any level, and for Competitive-30 where $p = .015$. This gives support to the idea that equalization of payoffs is viewed as the socially or morally desirable outcome when its achievement does not compete with strict personal interest or total payoff maximization.

Interestingly, keeping exactly five tokens appears to be more prominent when choices are made hypothetically, especially in the deterministic case and, interestingly in Noncompetitive-10. Also in the Deterministic-10 substantial fraction of subjects (22%) made a choice (nearly) resulting in equalization of payoffs (thus kept 7 or 8 tokens).

Concerning treatment effects, a glance at tables 3 and 4is enough to see that the higher the own prize, the more 'selfish' the choices. This is true for all three kinds of games. A conservative nonparametric Cuzick's (1985) test of trend confirms that 'self' increases with own prize for each game type separately at $p < .05$, also for dictators and dummies separately, except for the Deterministic case for dummies. Prize seem to play a major role in determining subjects' behaviors, although at the aggregate level its influence is contrary to the one intuitively expected from inequality aversion.

Comparing choices across game types we see that decisions are less selfish in the Deterministic as well as in the Noncompetitive case than in the Competitive one. This can tested by taking pair-wise differences of sums of decisions in separate blocks for each subject (*e.g.* summing three choices in Deterministic treatments and subtracting three choices in Competitive treatments) and testing whether the resulting subject-specific variable is significantly different from 0. A non-parametric Wilcoxon test rejects the hypothesis that difference between Deterministic and Competitive case is null ($p < .01$) and this appears to hold both for dictators ($p = .03$) and dummies ($p = .08$). Difference between Deterministic and Noncompetitive is only (marginally, $p = .08$) significant for dictators and no significant difference can be found between the two probabilistic treatments.

The differences in the number of tokens kept may appear low, but this is largely driven by the fact that majority of subjects consistently behaved in a (nearly) selfish ways. If we consider only the non-always selfish subjects, using the clustering procedure described above, the variation seems quite substantive: the number of tokens given varies from a maximum 3.27 (Deterministic-20) through 2.86 (Noncompetitive-20) to 2.18 (Competitive-20). In other words, pro-social A-players give on average50% more in the Deterministic treatment than in the Competitive treatment in the case of symmetrical prizes.

Table 5 reports a random-effect panel regression of the variable 'self' on a number of covariates. The regression analysis is consistent with findings reported before: Subjects are more selfish in the probabilistic treatments (especially 'Competitive') than in the baseline deterministic condition. Own prize has a strong positive impact on the number of tokens kept. Actual

self	Coef.	Std. Err.	$P >\mid z \mid$
dictator	1.25	.30	0.000
Competitive	.39	.11	0.000
Noncompetitive	.22	.11	0.049
prize	.04	.0056	0.000
period	.08	.018	0.000
male	.36	.32	0.294
economist	.46	.37	0.209
religion	-.61	.31	0.051
foreign	.50	.32	0.122
cons	5.77	.48	0.000
sigma u	1.58		
sigma e	1.55		
rho	.51		

Random-effects GLS regression, Number of obs = 1152 ; Group variable (i): uniqueID, Number of groups = 128; R-sq: within = 0.0734, Obs per group: min = 9 ; between = 0.2042, avg = 9.0; overall = 0.1508 , max = 9 ; Random effects u_i Gaussian, Wald $\chi 2(9)$ = 112.09; corr(u_i, X) = 0 (assumed), Prob > $\chi 2$ = 0.0000

Table 5: *Regression*

dictators are much more selfish than dummies. New insights concerns the impact of other variables: Subjects appear to be somewhat more generous at the beginning than later on perhaps because of some well-known 'entitlement effect'; economists are not found to be more selfish or at least the effect is not significant, contrary to several earlier studies; individuals who declare to be religious are slightly more pro-social and foreigners do not differ systematically from Dutch subjects. Results from a less-easily interpretable ordered probit regression are quite similar.

We have also conducted some additional analyses and robustness checks. First, we have looked for the impact of risk attitude as measured in the additional Certainty Equivalent deterimination task. We were not able to find any relation with the decisions in Dictator Games. This negative result could partly be due to confound with income effect – selfish participants tended to be richer after the first part. Second, we analyzed the data on satisifaction from the game and own decision and found that it was predominantly determined by the amount of money earned. Finally, we have checked for possible order effects (of blocks and rounds) and did not find any.

To summarize, prizes play a role in the determination of subjects' choice, with more generous decisions occuring when partner's prize was high. The effect of game types appears less important, yet it seems that at least under the competitive incentive scheme outcomes are different from the standard, deterministic treatment. On the whole, participants appear to be quite selfish in all treatments and when they do share, they still typically keep most tokens.

6 Discussion of the findings in view of theoretical models

As in many other studies, the hypothesis that all subjects maximize their own payoffs falls short in all situations. Still, it is important to put forth that two-third of subjects did behave nearly selfishly; thus, the treatment effects that we do observe are necessarily driven by behavior of a minority of subjects.

Although models based on this idea predict correctly in some treatments, especially the standard DG, there is on-the-whole little evidence of inequality aversion in our data: Choices actually increase in own prize, thus accentuating differences between final outcomes. The failure to explain aggregate data in terms of inequality aversion could be due to heterogeneity of players– for instance a few efficiency-oriented subjects might influence strongly the distribution of tokens kept across prizes. Yet, when focusing on the individual data, there appears to be only one player sufficiently equality driven to choose the payoff equal split for all prizes (ID 223). Even if we apply a very loose selection criterion and consider as inequality-averse those subjects with choices (weakly) decreasing in own prize, we find only 2 subjects conforming to it. On the contrary, models based on the assumption that subjects tend to maximize, *ceteris paribus* the total surplus such as suggested by Andreoni and Miller , and proposed by Charness and Rabin do find some support.[11]

When dealing with the effect of game types, it is sufficient to consider the symmetric $(20, 20)$ treatments to see that predictions of all models fails in some cases. Indeed, inequality aversion based models imply that in the Competitive treatment all socially-oriented subjects should choose to keep all the tokens. This is clearly not the case: in Competitive-20, these subjects, as determined by the clustering procedure, have given on average 1.20 tokens within a bimodal distribution (around 5 and 10). Some subjects at least seem to consider equity in terms of expected payoff and as such cannot be described by the maximization of expected (inequality-based) utility. In particular, the fact that Noncompetitive-20 and Deterministic-20 appear so similar is not predicted by these models and represents a puzzle.

Although it performs much better in the case of asymmetrical prizes, the expectation-extended model of Charness and Rabin does not lead to better predictions in the Competitive case, and may even lead to less accuracy for the Noncompetitive case.

As explained before, the failure of the outcome-based models is not due to their specific functional forms. Our results cast doubts about the possibility to account for pro-social behavior in a consequentialist way: whatever criterion is used by subjects in their social concerns, it seems to require to take into account the *ex ante* distribution of chances. This would straightforwardly imply that the separability of objective functions, probabilities on one side and utility/consequences on the other, does not hold at least for a non-negligible share of subjects. This view is also supported by the fact

[11] Yet, it is worth noting that our design, which tries to get rid of possible equality of opportunity reasonnings by subjects, for instance by using a very specific assignment of roles and by not using the'strategy method', is not completely secure from this point of view. It might be the case indeed that sophisticated subjects maximize and equalize expected payoffs for themselves and the other player. They would exactly look like total payoff maximizer, although they simply are *efficiently inequality averse* on expected payoffs.

that risk attitude played a limited role, if any, in determining decisions in the Noncompetitive treatment compared to the Deterministic one.

Trautmann's non-consequentialist model on the other hand, predicts correctly that behaviors in Noncompetitive-20 do not diverge from Deterministic-20, or at least this difference is not strong enough to be significant. But it fails to predict that Competitive-20 is different. More importantly, we find very little expected-outcome equalizing in asymmetric probabilistic treatments. Approaches based on extension of the Bolton-Ockenfels models such as Bolton and Ockenfels. (2006) and Krawczyk (2007) are consistent with the data, which however comes at a cost of generating much less sharp predictions in the first place.

7 Conclusion

We take a few main lessons from the results of the experiment. First, that a simple mechanical generalization of outcome-inequality aversion models–multiplication of utility assessments by relevant probabilities–is not a promising way to model social behavior in risky situations. Actually, all models based on this consequentialist approach are bound to fail to account for the fact that many individuals are willing to share chances in a 'competitive' dictator game. Likewise, as this context induces less generous choices than the standard dictator game, suggestions that all (non-selfish) agents only consider fairness of opportunities seem also to miss some important point. Whether a tractable and psychologically appealing model capable of generating sharp predicsions and allowing for both aversion to outcome- and opportunity-inequality can be formulated, remains to be seen.

Second, we note that choices are much more generous and 50-50 splits much more common when decisions are made hypothetically. This tells us that sharing equally in dictator game-like situations may be a socially-desirable norm of behavior, which however is quite easily overridden when (sufficient) monetary incentives come into play. More generally, purely distributive decisions are known to be quite sensitive to rather subtle changes in the game environment, the way in which the problem is posed, etc. Earlier studies typically involved only a special case of symmetric deterministic dictator game. Equal split may be prominent in such a case (which to some extent has driven emergence of models assuming that agents value perfect equality of outcomes). Our, more general treatment suggests that without such a powerful clue coming from symmetry of the single problem, most agents behave rather selfishly. Moreover, even those who feel they should share, choose to give just 'something', but quite rarely go for an equal split of money (or chances to win it) or for equalization of expected payoffs.

This finding contributes to the explanations of why the level of redistribution seems to be related to the belief in equality of opportunity (as in the notorious US vs. Europe example). Indeed, nobody could reasonably argue that all US-citizens are actually given *equal* chances; apparently, however, already a small chance offered to the other participant is enough to extinguish the feeling of guilt in our experiment. Similar mechanisms may be at work at the macro-scale as well.

Last but not least, the existence of probabilistic social concerns might raise critical methodological issues in experimental economics. Most experimental designs are based on an explicitly random assignment of roles and therefore the assumption is implicitly made that it has no effect. But, if subjects are fully aware of that, they may think that given that the *ex ante* chances to be for instance a dictator are equal, then grabbing all the pie is fair. It may lead to a systematic underestimation of social concerns.

By the same token, findings on willingness to share chances equally call for reconsideration of some of the previous evidence against the inequality-aversion based models. It has been suggested before (Trautmann, 2006, Krawczyk, 2007) that experimental design comparing responses to human-made and random computer-made offers (Blount, 1995) is not a valid way to discriminate between distributional concerns and emotional (anger) reactions, as random offers are actually more (ex-ante) fair. Similarly, evidence for welfare maximization and against inequality aversion (e.g. Andreoni and Miller, 2002) has to be treated with caution, as sharing more when it benefits the other participant more may be a good way to increase own payoff, while achieving fairness (in expected terms) across rounds. It would be desirable to replicate these findings with a between-subjects, single-decision design without the use of the strategy method.

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Appendix I: Theoretical Predictions

Predictions for Pure Inequality Models

'Deterministic' case

In the case of two players, we can consider Fehr-Schimdt and Bolton-Ockenfels as special instances of the following model. Focusing on the dictator we denote his/her payoff by π_1 and define the payoff difference: $\delta = \pi_1 - \pi_2$

Note that δ could be equivalently defined as the share (say σ) of the pie, as in BO. The definition above should just be adapted with $\sigma = \frac{1}{n} \iff \delta = 0$.
Let $u_1(\pi_1, \delta)$ be the utility function satisfying

$$\frac{\partial u_1}{\partial \pi_1} \geq 0$$

$$\frac{\partial^2 u_1}{\partial \pi_1^2} \leq 0$$

$$\frac{\partial u_1}{\partial \delta} = 0 \; if \; \delta = 0$$

$$\frac{\partial u_1}{\partial \delta} > 0 \; if \; \delta < 0$$

$$\frac{\partial u_1}{\partial \delta} < 0 \; if \; \delta > 0$$

For the sake of simplicity we will now refer to u as a function from π_1 and π_2. The general shape of this function implies immediately that the number of tokens (hereafter x) kept in Deterministic treatment is such that either $\sigma_1 > \frac{1}{2}$, meaning that x is in $[5; 10]$ for Deterministic-20, $[2.5; 10]$ for Deterministic-30, or $[7.5; 10]$ forDeterministic-10.

7.0.1 'Competitive' case

In the general case, relations the between $u(20, 0)$ and $u(0, 20)$ is undetermined. Hence, we will add the following reasonable assumption: For the same level of absolute inequality, envy is more important than guilt.

Assumption 1 (Self-serving assumption) *For any strictly positive x and y, $u(x + y, x) > u(x, x + y)$.*

This seems in line with most results. Then, we have $u(20,0) > u(0,20)$. As a consequence, maximizing the corresponding utility function:

$$U(p) = pu(20,0) + (1-p)u(0,20)$$

straightforwardly implies that $\text{Argmax}_p U = 1$. It is not impossible that an agent that would only be motivated by fairness, and not by his/her own payoff would be indifferent between both outcomes, p can hence take any value between 0 and 1. This result can be generalized to the case where prize are asymmetrical. It is of interest that in Competitive-30, it might become more plausible that $u(30,0) = u(0,10)$ and hence that some subjects are indifferent with $p \in [0,1]$.

'Noncompetitive' case

In the case of non-competitive treatments, four outcomes are possible (20; 20), (20; 0), (0; 20) and (0; 0). The generic model defined above implies that $u(20,20) \geq u(20,0)$, $u(20,20) \geq u(0,0)$ and $u(0,20) \leq u(0,0)$. The math can be found in the subsection below, and its results can be summarized as follows:

- when inequality aversion is strong enough (see condition in equation 9), then p^* the probability maximizing the above utility function should be in $[\frac{1}{2}, 1]$
- when $p^* < 1$ then the numbers of token kept in Deterministic-20 is less than 10.

The line of reasoning is similar for Non-Competitive-30 and Non-Competitive-10.

Predictions for Quasi-Maximin Models

'Deterministic' case

Once again $u_1(\pi_1, \pi_2)$ is the utility function. Taking Rabin and Charness' model gives us

$$u_1(\pi_1, \pi_2) = \gamma\pi_1 + (1-\gamma)[\alpha \min(\pi_1, \pi_2) + (1-\alpha)(\pi_1 + \pi_2)]$$

This implies immediately that depending on the α and γ parameters, the number of tokens kept in Deterministic treatment is such that x is in $[5, 10]$ for the symmetric case.[12] For Deterministic-30 the range is $[2.5, 10]$, extreme values are reached when subjects are mainly concerned by maximin (high α and low γ) for 2.5 and when subjects are either selfish (γ is high) or rather concerned about total payoff (not too low γ and low α) for 10. For Deterministic-10, the range of possible choice is $[0, 10]$, the 0 and close choices are the case when subjects are primarily concerned by total payoff, the 10 one when mostly considering own payoff. It is noteworthy that in the case of chiefly maximin oriented subjects, they should choose numbers around 7.5.

'Competitive' case

The situation is similar to the one exposed in the previous subsection. Hence, if $(20; 0) \succ (0; 20)$, as is implied by the symmetry of the Charness and Rabin's model, when parameters do not take extreme values–namely $\gamma = 0$ and $\alpha = 1$, dictators should keep all tokens. In a more general case, it cannot be ruled out that that $u(20; 0) \leq u(0; 20)$ which would induce either $x = 0$ or the agent is completely indifferent; yet such a case is very unlikely. The same line of argument as above holds for any other distribution of prizes. It is also of interest to see that if some subjects are sufficiently concerned by total payoff, they might consider $(0, 30)$ as more valuable than $(10, 0)$. In general they should, most of the time choose $p = 1$, and on some rare occasions be indifferent among $[0, 1]$ and on even rarer occasion choose $p = 0$ in Comp10.

'Noncompetitive' case

The only major difference with the case of the pure inequality aversion model is that in addition with previous cases, it is also possible that $u(0, 20) > u(0, 0)$. This leads in general to $p = 1$.

[12] Strictly speaking it is possible that some total payoff maximizer may be completely indifferent on the $[0, 10]$ range with γ and α being null. This is a very unlikely case.

Calculus for the Maximization in the case of Non-Competitive treatments

Symmetric case

The possible consequences are $(20, 20)$, $(20, 0)$ and $(0, 20)$ and eventually $(0, 0)$. The expected utility takes, in the general case the following shape:

$$EU(p) = p(1-p)u(20,20) + p^2u(20,0) + (1-p)^2u(0,20) + p(1-p)u(0,0) \quad (1)$$

That is, after some algebra:

$$EU(p) = p^2\left[u(20,0) - u(20,20) + u(0,20) - u(0,0)\right] + p\left[u(20,20) - 2u(0,20) + u(0,0)\right] + u(0,20) \quad (2)$$

It is immediate, with $f(p) = EU(p)$, that:

$$f''(p) = 2\left[u(20,0) - u(20,20) + u(0,20) - u(0,0)\right] \quad (3)$$

and that

$$f'(p) = 2p\left[u(20,0) - u(20,20) + u(0,20) - u(0,0)\right] + \left[u(20,20) - 2u(0,20) + u(0,0)\right] \quad (4)$$

First, consider the case where $u(20,0) - u(20,20) + u(0,20) - u(0,0)$ is positive. This would imply by setting $u(0,0) = 0$:

$$u(20,0) + u(0,20) > u(20,20) \quad (5)$$

This case cannot happen in the models under scrutiny.

Now, the case $u(20,0) - u(20,20) + u(0,20) - u(0,0)$ is negative, we have f reaching a maximum when:

$$p^* = \frac{-u(20,20) + 2u(0,20) - u(0,0)}{2\left[u(20,0) - u(20,20) + u(0,20) - u(0,0)\right]} \quad (6)$$

This p^* is lower than 1 when

$$u(20,20) - 2u(0,20) + u(0,0) < -2u(20,0) + 2u(20,20) - 2u(0,20) + 2u(0,0) \quad (7)$$

That is to say:

$$u(20,20) + u(0,0) > 2u(20,0) \tag{8}$$

It is quite natural to normalize u so that $u(0,0) = 0$. Hence we have

$$p^* < 1 \iff u(20,20) > 2u(20,0) \tag{9}$$

Note that it is an interesting case since it implies that $u(10,10) > u(20,0)$ by concavity:[13]

$$2u(10,10) > u(20,20) > 2u(20,0)$$

Hence it requires that the Deterministic-20 treatment the corresponding subjects gives at least some tokens to the dummy players. Note also that it does not imply that the subject divide equally since it might be the case that the maximum of the function is reached between $(10,10)$ and $(20,0)$, but at least that the maximizing value cannot be $(20,0)$. Moreover, p^* is positive if we have

$$p^* = \frac{-u(20,20) + 2u(0,20) - u(0,0)}{2\left[u(20,0) - u(20,20) + u(0,20) - u(0,0)\right]} \geq 0 \tag{10}$$

Assuming that the denominator is positive, this implies that

$$-u(20,20) + 2u(0,20) - u(0,0) > 0$$

Which is not possible by assumption. Turning to the case with the denominator of 10 negative, we have:

$$u(20,20) > 2u(0,20) \tag{11}$$

Intuitively, it seems likely to be satisfied. It also note worthy that in this case we have, given the condition on the denominator:

$$u(20,0) - u(20,20) + u(0,20) - u(0,0) < 0 \tag{12}$$

That is:

$$u(20,0) + u(0,20) - u(20,20) < 0 \tag{13}$$

[13] In the case u is linear, as is often true in models, then it implies that the subject is indifferent between $(10,10)$ and $(20,0)$ and all intermediate values.

This means that social concerns actually exist, else $u(0,20) = u(0,0) = 0$ and $u(20,20) = u(20,0)$. It also implies that the utility function is different from the sum of two separable functions of both payments.

More precisely, the value taken by p^* is always greater than one half, since:

$$[-u(20,20) + 2u(0,20) - u(0,0)] - [u(20,0) - u(20,20) + u(0,20) - u(0,0)] = u(0,20) - u(20,0)$$

Which is negative. So,

$$\frac{[-u(20,20) + 2u(0,20) - u(0,0)]}{[u(20,0) - u(20,20) + u(0,20) - u(0,0)] = u(0,20) - u(20,0)} > 1$$

And hence $p^* > \frac{1}{2}$.

Dictator-favoring case

In the case prizes are $(30,10)$, the line of reasoning is the same. It then gives us:

$$EU(p) = p^2 [u(30,0) - u(30,10) + u(0,30) - u(0,0)] + p [u(30,10) - 2u(0,10) + u(0,0)] + u(0,10) \tag{14}$$

Therefore:

$$f''(p) = 2 [u(30,0) - u(30,10) + u(0,10) - u(0,0)] \tag{15}$$

and that

$$f'(p) = 2p [u(30,0) - u(30,10) + u(0,10) - u(0,0)] + [u(30,10) - 2u(0,10) + u(0,0)] \tag{16}$$

First, consider $u(30,0) - u(30,10) + u(0,10) - u(0,0)$ is positive. Using as usual $u(0,0) = 0$:

$$u(30,0) + u(0,10) > u(30,10) \tag{17}$$

This case is very unlikely in the models under scrutiny: It would indeed require a very specific shape for social concerns. Anyway, in this case we would have f' increasing on $\mathbb{R}$ and f reaching a minimun at

$$p^* = \frac{-u(30,10) + 2u(0,10) - u(0,0)}{2 [u(30,0) - u(30,10) + u(0,10) - u(0,0)]} \tag{18}$$

This would take the sign of $-u(30,10)+2u(0,10)-u(0,0)$, which cannot be positive since it would imply $u(30,10) < 2u(0,10)$[14]. As a consequence, the minimum is reach for some p^* which is negative, and f is increasing on $[0,1]$, so the maximum is reached at $p = 1$.

So only the case where $u(30,0) - u(30,10) + u(0,10) - u(0,0)$ is negative is left. Following the same argument as for the case of $(20,20)$, it gives, when adapting the relevant equations:

$$p^* < 1 \iff u(30,10) > 2u(30,0) \tag{19}$$

This would require a very important of inequality aversion: the rather mild reduction of inequality would do more than compensate for twice the same payoff by the decision-maker. If it is the case, p would also be positive if, using equations RRR and RRR and RRR:

$$u(30,10) > 2u(0,10) \tag{20}$$

Although not necessary given the general form, it is extremely likely that it holds. In this case then, p would belong to $[0,1]$. For the same reason as in the case $(20,20)$, $p > \frac{1}{2}$.

Dummy-favoring case

The case that prizes are $(10;30)$ is less precisely determined given that in this case, we will assume that $[0,1]$ is the range of possible outcomes.

[14] It would not be strictly speaking impossible when considering a generalization of Rabin and Charness' model with a strongly concave separable function on total payoff, and (almost) no concern for own payoff, but this seems to be implausible if not pathological.

Appendix 2: Instructions:

Only player A's instructions are reproduced here, with one specific block order and one specific examples. As a reminder we used three different block orders (one per session) and three different examples (two per sessions). Both variables do not seem to have had any statistical impact.

First Handout

Welcome to this experiment in decision-making, in which you can earn some money. Your earnings will depend on your decisions, decisions of other participants and luck. Anonymity is guaranteed Â– nobody will be able to link your decisions to you. Your earnings will be paid privately in cash, immediately after the session.

NB: You have already earned 7.50 euro for showing up on time. Whenever earnings are mentioned in the instructions, it refers to earnings in addition to this show-up fee.

Today's session will actually consist of two separate experiments. The second experiment will consist of individual decisions, where only your own choices will matter. It is completely independent from the first experiment and offers identical chances to earn money to everyone. This handout explains the first experiment.

The participants have been divided into two equally numerous groups, A and B. This assignment will hold for the whole experiment (but not for experiment 2). Below, we shall thus speak of A-participants and B-participants.

Role assignment has been decided by the order of arrival: some participants have picked yellow cards corresponding to the role of A-participant and the others some corresponding to B-participant. Note that in general it does not mean that for instance early arrivals correspond to any specific role.

You have been assigned to the role of participant A.

The experiment will consist of nine rounds. In each round each A-participant will be randomly and anonymously paired with one B-participant. You will not be matched with the same person twice. **Each A-participant will be asked to divide 10 'tokens' between him/herself and participant B.** That is to say, A can keep all tokens to him/herself, keep some tokens to him/herself and pass the rest to B, or pass all tokens to B. A can also leave some tokens unallocated. **Each token represents either some monetary amount or some chance of winning some prize. These prizes or monetary amounts may be different from one round to the other and for A- and B-participants.**

The nine rounds of this experiment have been divided into three blocks: Rounds 1-3, 4-6 and 7-9. **Exactly what each token represents will vary from one block to another.** All other rules (such as fixed assignment to roles, changing prizes) will remain unchanged. You will receive additional instructions about the value of tokens at the beginning of every block.

Only one out of nine rounds will be played for real money: the decisions made in this round will actually affect the earnings. The computer has already randomly selected this round. But, as you do not know which round will matter, you should make careful decisions in each round. To determine earnings, dice will be rolled, depending on what each token represents in a given block.

No decision will be revealed to anyone before the last round. For example, nobody will know what another participant has chosen in the current or past rounds. After the last round each B-participant will learn how many tokens the A-participant s/he was matched with in the selected round has allocated to her or him. Of course, the identity of this A-participant will remain unknown.

You might have noticed that B-participants will have no opportunity to affect the earnings. They will be asked the same questions. However their decisions will have no monetary consequence.

Handout 2

Block 1: Rounds 1-3

In this block, one token represents a chance of 1 over 10 to earn a prize. Prizes may be different for A-participants and B-participants. If one of the three rounds corresponding to this block is chosen for payment, **two dice will be rolled: one for the A-participants and another for the B-participants,** with chances of winning their prizes being determined by the allocation of tokens. For any participant (either A or B), any outcome of the corresponding die lower than or equal to his/her allocated number of tokens will mean that the prize is won; otherwise nothing is earned by this participant.

Example: Suppose that in some round participant A's prize is 20 euro and participant B's prize is 10 euro. A allocates 7 tokens to her/himself and 3 tokens to B. (The picture below shows how this would look like on the screen. Note that information on prizes that change from round to round is displayed in bold). Thus A has a chance of 7 over 10 (70 % chance) of winning her/his prize, while independently B has a 30% chance of winning hers/his. Suppose that this round is selected for real payments. One 10-sided die is rolled for participant A (actually, the same outcome will matter for all A-participants). If the outcome is 1, 2, 3, 4, 5, 6 or 7, A wins 20 euro; if it is 8, 9 or 10, s/he wins nothing. Next, a 10-sided die is rolled for participant B (all B-type participants actually). If the outcome is 1, 2 or 3, B wins 10 euro. Otherwise, she or he wins nothing.

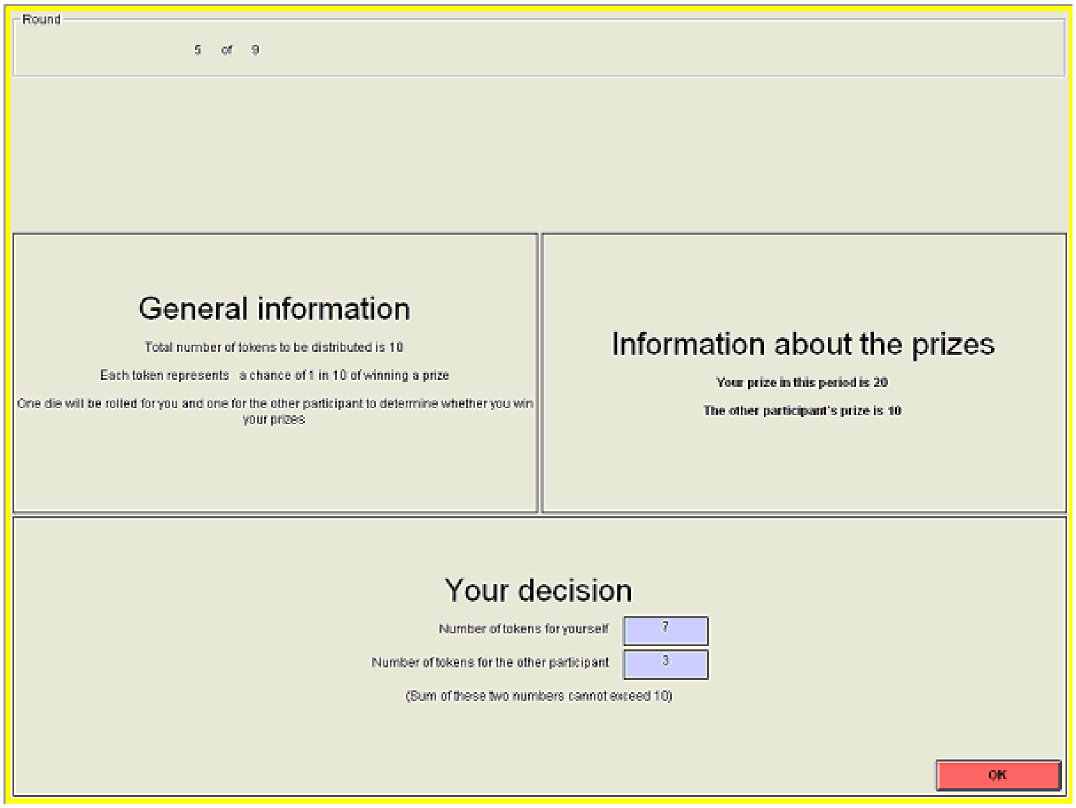
For the actual game, the values of prizes will in general be different. Please raise your hand if you have any questions. Otherwise, click the button on the screen.

Handout 3

Block 2: Rounds 4-6

In Block 2 (rounds 4-6), one token represents a fixed amount of money. This amount may be different for A-participants and B-participants. **This amount is equal to one tenth of the prize, such that all 10 tokens correspond to the full value of the prize.**

*Example: Suppose that in some round participant A's prize is 20 euro; participant B's prize is 10 euro. Thus each token is worth 2 euro for A and 1 euro for B. Participant A decides to allocate 7 tokens to herself and 3 tokens to B. A earns 7*2=14 euro and B earns 3*1=3 euro.*



Otherwise, the rules remain unchanged: participants are re-matched after every round, prizes change between rounds, 10 tokens are to be allocated, role assignment remains unchanged, only A-participants can affect the earnings, no decisions are revealed to others.

Please raise your hand if you have any questions. Otherwise click the button on the screen.

Handout 4

Block 3: Rounds 7-9

In the remaining rounds (Block 3), one token represents 1 chance over 10 to earn a prize. If one of these rounds is selected, **one 10-sided die will be rolled to**

determine earnings of both A-participants and B-participants. When the outcome is less than or equal to the number of tokens that A kept for her/himself, s/he will win the prize and B will not. If it is greater, B will win the prize and A will not. In other words, **there is one prize to be won per pair (albeit of different value for different participants) such that A and B cannot win simultaneously.**

NB: In the case that A allocates less than 10 tokens in total, nobody will win for the outcomes greater than the number of tokens kept by A and less than '11 minus the number of tokens given to B'.

Example: Suppose that in some round participant A's prize is 20 euro; participant B's prize is 10 euro. Participant A allocates 7 tokens to him/herself and 3 tokens to B and this round is selected for real payments. One 10-sided die is rolled: if the outcome is 1, 2, 3, 4, 5, 6 or 7, A wins her/his prize of 20 euro and B wins nothing. If the outcome is 8, 9, or 10, A wins nothing, while B wins her/his prize of 10 euro.

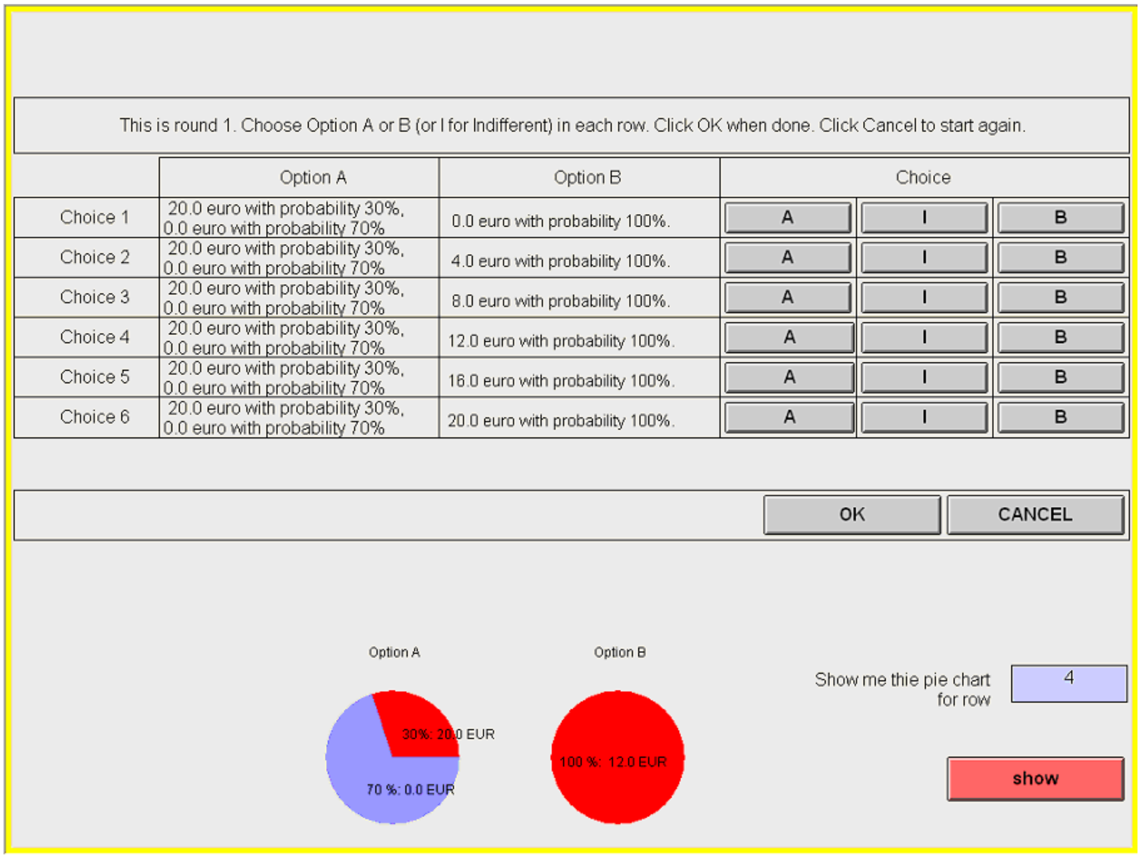
Otherwise, the rules remain unchanged: participants are rematched after every round, prizes change between rounds, 10 tokens are to be allocated, role assignment remains unchanged, only A-participants can affect the earnings, no decisions are revealed to others.

Please raise your hand if you have any questions. Otherwise click the button on the screen.

Handout 5

In this experiment you are asked to make a number of choices between options A and B. Option A always involves a "Risky prospect" Â– it gives a chance to win 20 euro with some probability and 0 otherwise. Option B simply gives some amount for sure.

There are three rounds. You will notice that within each round Option A stays the same, while the amount involved in Option B increases as you go down the table (see the screenshot below).

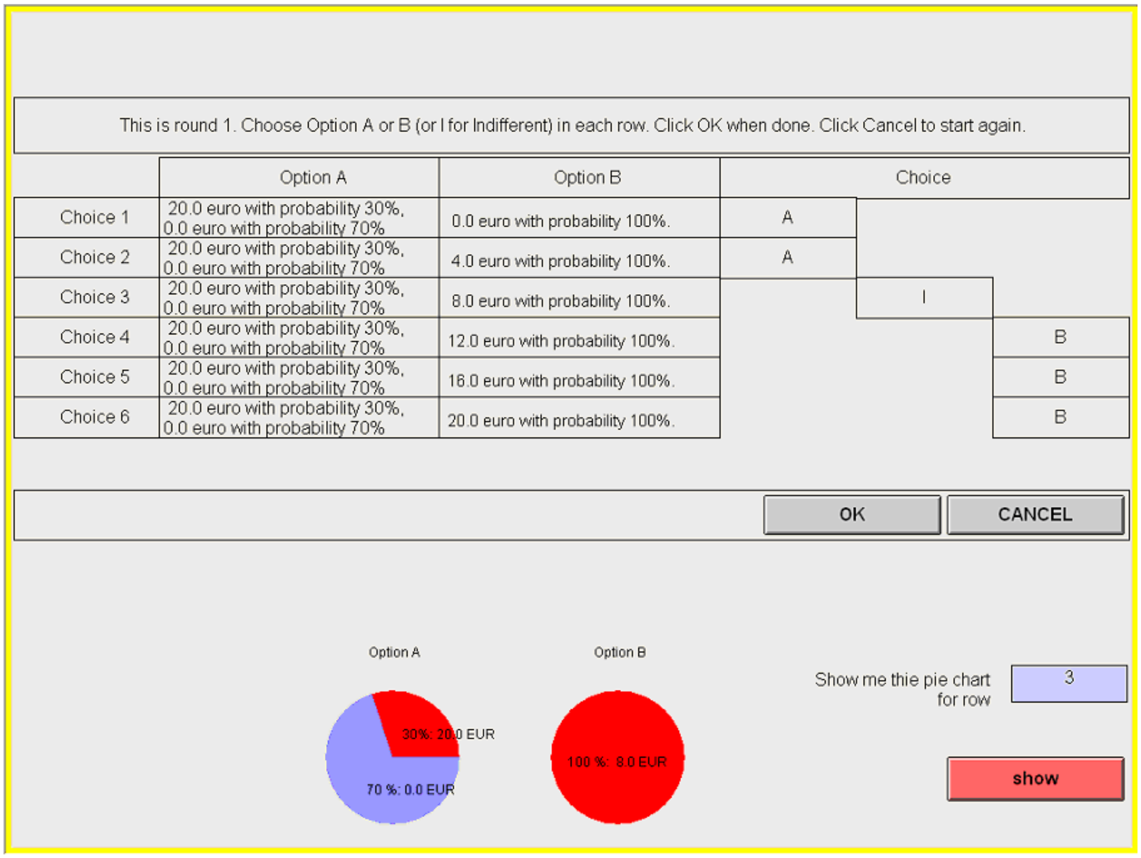


Your task is to choose between A and B in each row, or click I (indifferent) when you find both options in this row equally attractive. The screenshot below shows one possible set of choices.

In this example a participant preferred the risky project (Option A) as long as the sure payment in Option B was lower than 8 euro, was indifferent for the sure payment of 8 euro and preferred the sure payment if it was greater than 8 euro.

As it would not make sense for instance to prefer Option A to 12 euro but prefer 8 euro to Option A, some options will disappear as you make choices in other rows.

Of course, when making your choices, you do not have to be exactly indifferent in any particular row. If you indeed do not choose 'I' even once, you will see



an additional table with values in option B between the last row in which you preferred A and the first row in which you preferred B.

After you have made all the choices, please click on the OK button. If you make a mistake, you can cancel your choices by clicking on the CANCEL button.

Below the table you can see graphs representing Option A and, after you choose the row for which you would like to see it and click 'Show', Option B. They are meant merely as additional help in your decisions Â– you can disregard them if you wish.

After you have made all the decisions, one of your decisions might be implemented, that is, one choice from one of the rounds might be selected, in which case you will receive the option you preferred in this problem. In the example given above, the computer may for instance choose an amount of 4 euro. For this amount the participant in question preferred the risky prospect (Option A) so this is what s/he will receive. If Option A is preferred in the selected choice, the risk will be resolved by means of a die roll: for example, if it involves a 40% chance, you will receive 20 euro if the outcome of the die roll is 1, 2, 3 or 4 and nothing otherwise (5, 6, 7, 8, 9, 10). If you chose Option B, you will simply receive the sure amount. If you choose I, A or B will be selected randomly.

Similarly to the first experiment, there is a chance of 1 over 9 that each particular problem will be played for real. Only one problem might be selected for real payment. Note that, given that there are three problems, it is quite possible that none of your decisions is implemented, resulting in zero income for this experiment. As one of your choices might be played for real (and you cannot choose which one), it is in your best interest to choose carefully in each row.

Whatever you earn will be added to your earnings from the first experiment and paid out in cash.

Please raise your hand if you have any questions.