Risk Attitudes and Fairness: Theory and Experiment

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Abstract

I introduce an integrated model of risk attitudes and other-regarding preferences that extends the standard notion of inequity discount to lotteries. In this model, a decision maker perceives inequity partly by comparing the marginal risks she and others face. It predicts that fairness considerations will alter risk attitudes, in particular, a higher tolerance to positively correlated (fair) risks compared to negatively correlated (unfair) risks. It is also capable of explaining the behavior by which people help others probabilistically (known as ex ante fairness). Furthermore, in contrast with the existing view of ex ante fairness based on expected outcomes, my model does not imply that stronger ex ante fairness behavior is associated with less risk sensitivity. I study these predictions with evidence from an experiment. I find that subjects take more risks when outcomes are ex post fair compared to when they are ex post unfair. I confirm ex ante fairness behavior is a common choice pattern and document how, according to the model, it responds to its relative price. Finally, I reject the implication of existing models that stronger ex ante fairness behavior correlates with less risk sensitivity. (JEL C72, D03, D63, D64, D81)

Keywords: Risk, Social Preferences, Fairness, Ex ante Fairness, Ex post Fairness

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1 Introduction

Many decisions we make have consequences not only for ourselves but for other agents we care about – or with whom we compare ourselves – and such consequences are uncertain at the moment we make the decision. Similarly, risk taking choices often occur in environments where comparisons with respect to others are unavoidable. Financial officers decide on risks borne by others; entrepreneurs make decisions that imply different risks for themselves and for their partners; climate change policies aim to increase the odds of positive outcomes for future generations; and colleagues competing for a promotion (or a prize) face uncertainty but also might exhibit concerns about unfair opportunities and unfair final outcomes. All these are examples where *risks* and *others* are both essential considerations in the decision.

In this paper, I research on two relevant aspects of the interplay between risk attitudes and other-regarding preferences. First, I ask to what extent the regard for the welfare of others affects risk attitudes. Second, I ask how the behavior in which people help others probabilistically (known as ex ante fairness) arises. To motivate these two questions, I start discussing two simple examples.

Suppose there are two people, you and a partner, and two coin-flip risks A and B. Both risks pay to you either 5 dollars or 20 dollars. Further, in each risk your partner's luck is determined by the same coin and involving the same amounts. But risks A and B differ in one thing: in risk A you two receive the same amount always, and in risk B you two are always paid unequally. Formally, $A : \frac{1}{2}(5,5) \oplus \frac{1}{2}(20,20)$ and $B : \frac{1}{2}(5,20) \oplus \frac{1}{2}(20,5)$. If you dislike both unequal outcomes and risks, then your desire to avoid risks will be higher for risk B than for risk A. Equivalently, you will optimally take more *fair risks* (like A) than *unfair risks* (like B), disregarding the fact they both expose you to the same marginal uncertainty.[1] You will behave differently facing the same personal risk.

This behavior – known as *ex post fairness* seeking – is a relevant pattern to study because, on one hand, it is predicted by standard extension of models with

[1]Notice I use the term "fair risk" to denote uncertainty that guarantees *ex post egalitarian outcomes* across agents. This should not be confused with the term "*actuarially* fair gambles" that in part of the literature denotes lotteries with zero expected value.

inequity aversion (Fudenberg and Levine, 2012), and, on the other hand, previous experimental research has suggested there is no link between social preferences and risk attitudes (Brennan et al., 2008; Bolton and Ockenfels, 2010) or that people prefer independent risks over correlated ones (Rohde and Rohde, 2011). As will be detailed below, my model predicts people will tolerate more risks that are ex post fair than risks that are ex post unfair, and my experimental evidence backs such prediction.[2]

Consider now this example related to my second question. As before, you and some partner that you care about are affected by your decisions. This time you have two mutually exclusive outcomes: one comparatively advantageous to you (outcome A) and one comparatively advantageous to your partner (outcome B). Suppose despite caring about him/her, you still prefer alternative A over B. However, if you can decide the chances of these two outcomes, you might choose to give B some chance of occurrence rather than no possibility at all. If so, you will *share* with the other person *the chance* that something "good" will happen at the expense of your own prospects.[3] In fact, while doing so, you are also taking on more risk. This type of behavior is known as *ex ante fairness* seeking, and experimental evidence shows it is a common behavioral pattern (Krawczyk and Le Lec, 2010; Brock et al., 2013). This raises the second main question of this paper: how ex ante fairness behavior arises. As pointed in previous literature (Krawczyk and Le Lec, 2010; Brock et al., 2013; Saito, 2013), while this is a common behavior it cannot be explained by theories purely based on the assessment of ex post outcomes such as our standard expected utility theory.[4] But it is not obvious how to extend the standard theory to incorporate ex ante fairness. One possible answer is that individuals with this kind of behavior present pro-social preferences but care

[2] In section 2, I offer an explanation regarding why previous experimental research either did not look into the right question or presented some design deficiencies.

[3] See corresponding decision tree in Figure 1.

[4] As we will discuss in the theory section, ex ante fairness behavior does not conform to the Expected Utility Theory because the *independence axiom* behind this theory implies option A will be strictly preferred to any non-degenerate lottery. This behavior is the same nature of *Machina's Mom* famous example in which a planner (aka mother) with two equally valued citizens and, sadly, only one indivisible good, might strictly prefer to randomize over who gets it instead of giving the item to one of the citizens with certainty (Machina, 1989).

little about risks and so for them, *sharing in chances* and in sure dollars look the same. An alternative view is that these people do care about risks but their sense of *equal opportunity* consists of comparing the possibilities or prospects to which each person gets access. In this view, an individual shares in chances because – to some extent – she wants both sides to have the *possibility* of favorable outcomes. The model I introduce in this paper corresponds to this latter view, while main existing theory of ex ante fairness (Saito, 2013) conforms to the former. Due to the strong implications about risk attitudes the existing view presents, I will argue in this paper that my model has conceptual and empirical relative advantages.

More specifically, in terms of theory, I propose a model that takes the following form:

$$U(L) = \mathbb{E}\left[W\left(g(x,y)\,,D(F_x,F_y)\right)\right] \tag{1}$$

where L is a lottery over two-people social outcomes $(decider, other)$, W is increasing in g and decreasing in D. g captures the main features of deterministic preferences and ex post fairness. D captures the *ex ante fairness penalty* by being sensitive only to differences in marginal risks. Although this model might look too general –it is after all defined over distributions– and therefore capable of organizing data better just by being more flexible, I show that, provided with the proper structure, it incorporates ex ante motives at the modeling cost of one single additional parameter. In that regard, it is comparable to the most utilized model (Fudenberg and Levine, 2012; Saito, 2013). In the new model, the conditions imposed on D are crucial. The most important and intuitive of these conditions is that D must extend the notion of *inequality discount* to the lottery space, in a way $U(L)$ behaves as a standard social preferences model in risk-free situations.

Let me show one example of how my model operates. Consider the following utility for lottery L: $U(L) = \mathbb{E}[x-(1-\delta)d(x,y)-\delta D(F_x,F_y)]$, where F_x and F_y denote the corresponding marginal risks, $D(F_x,F_y) = \int \frac{1}{2}|F_x - F_y|^2 dt$ and $d(x,y) = \frac{1}{2}|y-x|$. This extends the Fehr and Schmidt (1999) model to the uncertainty domain, while incorporating ex ante fairness motives when $\delta > 0$.[5] Importantly, in full certainty, $D = d$; which means ex ante fairness motives merge with the ex post

[5]For example, if $A = (1,0)$ and $B = (1,2)$, then a 50-50 lottery over A and B is strictly preferred to either A or B.

fairness motives, and the whole utility simplifies to $U(x,y) = x - \frac{1}{2}|y-x|$. That is, this instance of my model simply becomes an instance of the standard Fehr and Schmidt (1999) model (hereafter F&S).[6] Although this example gives a flavor of how my theory operates, it still lacks some important elements. First, because the F&S utility is piece-wise linear, it predicts that individuals are not responsive to the price of helping others. Second, it does not incorporate reasonable risk attitudes. For example, it predicts attitudes towards perfectly fair risks will be neutral. A full instance of my model will incorporate both: reasonable risk attitudes and convex deterministic preferences.

I contrast my model with the *expected inequality aversion* (EIA) model, introduced in Fudenberg and Levine (2012) and axiomatized in Saito (2013). In the EIA model, the decision utility of lottery L is given by $U(L) = \delta_s u(\mathbb{E}x, \mathbb{E}y) + (1-\delta_s)\mathbb{E}u(x,y)$, where $u(x,y)$ represents deterministic social preferences and δ the strength of ex ante motives.[7] I show that a core implication of this theory is that, holding other motives constant, more ex ante driven individuals will do more risk taking compared to less ex ante driven decision makers.

In the empirical section, I present evidence from a laboratory experiment that allowed me to study the main questions of the paper with observed behavior. Individuals in the study performed decisions in four different types of tasks. There were eleven decision rounds for each type of task. Task type 1 (the *sharing chance*s task) is the decision environment that elicits ex ante motives. Here each decision problem gives the *decider* two fixed, mutually exclusive (undominated) outcomes as in my first example above. Subjects are then asked to decide on the probabilities of these two outcomes. Task type 2 (the *taking fair-risks* task) elicits risk attitudes free of fairness concerns. In this task, subjects decide how much risk to bear in a two-state contingent commodity environment with the feature that either state of the world pays the same amount of money to the decider and her counterpart. Task type 3 (the *taking unfair-risks* task) elicits risk attitudes that also contain fairness concerns. In

[6] In this particular instance of the F&S model, I assume $\alpha = \beta = \frac{1}{2}$. But an asymmetric measure inside terms D and d replacing the absolute values will fully generalize F&S model for arbitrary α and β.

[7] In all mentioned papers, except Gaudeul (2013), $u(x,y)$ is the standard Fehr and Schmidt (1999) utility.

this task, subjects face the same environment as in task type 2, except in this task risks are perfectly negatively correlated; and each *state* pays unequally unless no risk is taken. Still, both subjects in each pair face the same marginal risks. Task type 4 is the standard *deterministic giving* decision environment where other-regarding preferences are elicited in a standard deterministic dictator-like game varying the budget and the price of giving.[8]

The experimental results are as follow. First, as predicted by my theory, I find that social considerations impact risk taking behavior in the ex post fairness seeking direction: subjects exhibited higher tolerance to fair risks (choices of type 2) than to unfair risks (choices of type 3). I also confirm ex ante fairness behavior is a rather common choice pattern and, building upon previous literature, I document how this pattern of choice indicates that ex post considerations are stronger than ex ante ones. Importantly, I empirically study the property of expected-outcomes-based models by which a stronger ex ante fairness behavior implies less risk sensitivity. The experimental evidence is not consistent with such behavioral pattern. To the best of my knowledge, mine is the only model consistent with the full set of evidence my experiment presents.

The rest of the paper is organized as follows: In Section 2, I discuss the previous theoretical and experimental literature. In Section 3 I present my model and discuss the main existing model. Section 4 describes the experimental design and procedures. Section 5 present the empirical results. Section 6 provides the main concluding remarks and discusses future research agenda.

2 Related Literature

The study of decision making incorporating uncertainty along with the consideration for others is relatively recent. Although attitudes towards risks are among the most studied matters in economics, for the most part they have been regarded as invariant or determined only by demographic characteristics.[9,10] Similarly, other-

[8]An attractive feature of my experiment is that the graphical interface utilized allowed me to elicit a larger set of choices compared to previous experiments.

[9]The first formal study of risk attitudes is almost three centuries old: Bernoulli (1954/1738).

[10]See Dohmen et al. (2011) for a study of demographic determinants of risk attitudes.

regarding preferences have been mostly studied in riskless environments (see e.g. Camerer, 2003; Fehr and Schmidt, 2006; and Meier, 2006).[11]

In recent years, the question about how other-regarding behavior operates under uncertainty has received more attention. Karni and Safra (2002) present a model of individual preferences over procedures that randomly allocate one indivisible item among N individuals. The decision maker in such a model has one *fair/moral self* that cares about others getting chances to get the prize, and one *egoistic self*. Balancing her preferences for equalized chances with her standard self-centered attitudes, the resulting combined preferences are capable of explaining ex ante fairness seeking behavior. Interestingly, the authors require these preferences to conform to expected utility theory when restricted to the set of fair procedures.[12] Though Karni and Safra's work is restricted to the specific case of one indivisible good, random procedures, and it does not discuss the role of risk attitudes, it can be thought of as a precursor of my model. Other models that are defined over distributions include Borah (2013). His model, presented axiomatically, has a representation that is linear with respect to two components: an individual's expected utility over social outcomes and a (ex ante) component that depends only on the risks faced by the *other* agent. One undesired feature of this model is that its departure from the expected utility theory remains even within perfectly fair uncertainty.

The majority of the remaining theories of fairness or altruism in probabilistic environments have a common property: they are based on the idea that people, in different degrees and manners, look at and compare expected outcomes. Bolton et al. (2005), for example, extend the ERC model (Bolton and Ockenfels, 2000) assuming, as in the original model, that people care about relative payoffs except these are replaced by *relative expected values*. Similarly, Trautmann (2009) extends Fehr and Schmidt (1999) to the uncertainty case by simply making the F&S inequality discount to depend on expected outcomes. In the same spirit, Krawczyk and Le Lec (2010) propose a formulation that linearly combines an egoistic expected

[11] Connections between decision theory under uncertainty and *social choice* theory have been studied for longer; see Gajdos (2005) for a short survey and Grant et al. (2012) for an example of a model of an impartial planner with ex post inequality aversion.

[12] As we shall see in the next section, this intuitive criterion is not met by some of the main models of a more general environment.

utility component and a fairness component that depends, in turn, on the (subjective) expected outcomes of the decider and the other agent. An issue with this last model is that it lacks of ex post fairness concerns.

A model that stands out is the *Expected Inequality Aversion* (EIA) model. Introduced in Fudenberg and Levine (2012) and axiomatized in Saito (2013), it has also been used to organize experimental data in Brock et al. (2013) and Gaudeul (2013). In this model, decision utility takes the form of a linear combination between the utility of expected outcomes $u(\mathbb{E}x, \mathbb{E}y)$ and the expected utility $\mathbb{E}[u(x,y)]$. $u(x,y)$ is the standard Fehr and Schmidt (1999) utility in all articles mentioned, except in Gaudeul (2013), where each individual outcome is replaced by a power function of the corresponding outcome. Since this model presents interesting features and has received the most attention of all theories based on expected outcomes, I discuss it further in the theory section and study it empirically along with the model I propose in the paper.

Experimental research on this topic has been active as well in recent years. Two bodies of research are the most relevant for the purposes of this paper: the experimental research on ex ante fairness and the studies of attitudes towards risks over social outcomes. In the case of ex ante fairness, Krawczyk and Le Lec (2010) and Brock et al. (2013) both document evidence from probabilistic Dictator-Game decisions like the one described in the second introductory example. In these tasks, subjects decide the chances of two fixed, mutually exclusive and undominated outcomes. In both papers, authors find *sharing in chances* (exhibiting ex ante fairness) to be a common behavior; at least one third of subjects assigned positive probabilities to unfavorable outcomes. However, only the first paper finds that subjects share less in chances than in deterministic terms (comparing the corresponding expected values).[13] Importantly, none of these papers discuss in depth the role of risk attitudes in these situations.[14]

[13] My experimental evidence shows the same pattern.

[14] Although not the same environment as my paper, Cappelen et al. (2013) research on a related aspect. They ask what are people's typical fairness views regarding risk-taking behavior. Fairness views are cleverly associated with whether or not an external observer redistributes post uncertainty payoffs in a society where subjects can choose different degrees of risk. Because an ex post *loser* comes in two flavors: he might have taken *too much risk* or he might have been just *too unlucky*, different redistribution to these two loser-types indicate different fairness views. They find great

In the case of attitudes towards risks over social outcomes, interestingly –and surprisingly– there is not a clear answer to the question whether individuals avoid risks with negative correlation (between their outcomes and others') more than risks with positive correlation. A central implication of ex post fairness is that people will strictly prefer positively correlated (more fair) lotteries over negatively correlated ones, so risk taking must be affected by social considerations. Nonetheless, Brennan et al. (2008) and Bolton and Ockenfels (2010) both claim there is no empirical link between fairness concerns and risk taking. There are, however, important design and analysis features in both works suggesting this conclusion needs to be re-examined. In the case of Brennan et al. (2008), their design does not allow them to directly test this hypothesis because outcome correlation, a key feature to elicit ex post fairness, is absent from all risky options in their design. My reading of their finding is that it only shows that the regard for others' risks is a very weak motive (which *per se* is an interesting finding). Bolton and Ockenfels (2010), on the other hand, do have alternatives where risks are perfectly correlated (positively and negatively) but in the pure comparison between each of these lotteries against a safe-fair option, their experiment only has 25 individual choices. This gives the authors insufficient statistical power. To gain power, they combine data from the correct comparisons (a perfectly correlated risk vs a safe-fair option) with other tasks where the safe option was unfair. Doing so, however, confounds risk attitudes with inequity concerns: if the safe options already have inequality built-in, the impact of fairness concerns in the attempted comparison is weakened. As expected by their low power and confounded statistical exercise, they find no significant difference in risk taking between fair-risks and unfair-risks. Rohde and Rohde (2011) report on an experiment testing whether "risk attitudes are affected by the risks others face". They find own-risk attitudes to be only marginally affected by others' risks. More importantly, subjects in their experiment strictly preferred imposing the same lottery uniformly on other subjects (for example where each other person receives an independent lottery yielding 20 euro with 30% probability and 10 euro

heterogeneity in people's fairness views. It must be noted that in this paper, however, the notion of ex ante fairness is defined over subject types (risk-takers and risk-avoiders) not only over social lotteries as is in my paper.

with 70%) over an unequal allocation with the same average value (i.e. paying 20 euro to 30% of these other subjects and 10 euro to the rest). They incorrectly used this finding (which is an ex ante fairness driven pattern) to claim that "people prefer risks to be independent across individuals in society rather than correlated". Although it is true there is correlation in the most chosen option, this correlation is rather weak even for small societies (laboratories for that matter). Therefore, it is not an appropriate design to study the role of risk correlation on risk attitudes.

Experiments in Gaudeul (2013) also include tasks with positively and negatively correlated risks. Although this paper reports individuals being "slightly more risk averse if outcomes are negatively correlated", there are two important shortcomings with the experimental design. First, the elicitation of preferences occurs via the BDM mechanism (Becker et al., 1964), which adds a layer of uncertainty to each choice problem. Second, the "safe alternatives" are never perfectly fair because by design their exact position is jittered randomly to make subjects "think" more carefully about the choice they face. In my view, this adds even another layer of decision processing that is problematic. In a context where inequality aversion is likely to be a central force shaping behavior, including options that are already (slightly) unequal might weaken the power of these motives. [15]

3 The Model

Setup: I focus on a two-person environment where each agent faces uncertain prospects over a single resource (money). Behavior is modeled via preferences for lotteries over social outcomes. Each ordered pair (x, y) indicates the resource allocated to the decision maker (DM) and her counterpart, respectively. The full set of outcomes $X \subset \Re^2_+$ is assumed to be convex. For the model to be meaningful, I assume at least some risks are *fairness-irreducible* in that ex post transfers

[15] Other less related, but still relevant papers are the following. Karni et al. (2008) study empirically the predictions of Karni and Safra (2002). Chakravarty et al. (2011) find that individuals making decisions for an anonymous stranger exhibit less aversion towards risks faced by the stranger than towards own risks. Van Koten et al. (2013) study risk attitudes restricted to uncertain pie-sizes in bargaining games. Finally, Harrison et al. (2012) study how risk attitudes towards social outcomes vary with information regarding risk preferences of the *other* agent, finding that learning others' risk preferences makes individuals more risk averse.

–i.e. reallocations after uncertainty is resolved– are not possible. I assume preferences $\succcurlyeq$ are rational, continuous and represented by a continuous utility function $U(L)$ of lotteries over outcomes in X. It is also assumed that, when restricted to degenerate lotteries, DM's preference relation $\succcurlyeq$ is strictly monotonic along the set $\{(x,y) : x = y\}$ and smooth *almost everywhere*. When it is not ambiguous, I use $U(F)$ as interchangeable with $U(L)$, if F is the CDF associated with lottery L.

In this environment, the following motives may potentially coexist: First, DM's regards for her own payoffs and risks. Second, DM's considerations for her counterpart's payoffs and risks. And, finally, DM could present fairness concerns in the *ex post* sense (i.e., preferences for risks that are positively correlated among agents over risks with negative correlation, Fudenberg and Levine, 2012) and in the *ex ante* sense (i.e., preferences for helping others probabilistically – *giving chances*).

The novel element of my theory is that it incorporates a notion of ex ante fairness based on *how balanced (marginal) possibilities are* distributed between DM and her counterpart. In this model, *ex ante forces* arise from a comparison of marginal risks, regardless the correlation of personal outcomes the joint risk implies. Every lottery where the two agents do not face the exact same marginal risk will be interpreted by DM as if they are not getting access to the same *opportunities* and therefore a utility discount will apply. This discount need not be symmetric: it can be lopsided towards discounting advantageous positions less than disadvantageous. Outside this ex ante discount, the rest of motives are modeled in standard fashion. The general formulation of my model is given in equation 2:

$$U(L) = \mathbb{E}W(\,g(x,y)\,,D(F_x,F_y)\,) \tag{2}$$

where W is increasing in g and decreasing in D. g, is the main component capturing standard deterministic social preferences and ex post fairness. It is assumed g is concave and increasing in its first argument and also along the 45 degree line. D is the penalty for ex ante unfairness. W's main role is to balance the relative strength of ex ante forces with respect to the rest of standard motives. A simple formulation for W that will accommodate most interesting and tractable instances is:

$$U(L) = \mathbb{E}W\left(g(x,y) - \delta D(F_x, F_y)\right) \tag{3}$$

I now discuss in more detail the ex ante fairness discount term, D. I describe first the properties we want D to exhibit and then provide an intuitive formulation that satisfies such properties. First, we want D to be well defined and bounded for arbitrary marginal risks F_x and F_y. Second, and more importantly, we want D to extend the notion of *inequality discount* that already exist in deterministic models to the lottery space. In particular, we want D to be minimized if and only if $F_x = F_y$. We can achieve this by defining D in relation to a notion of distance in the function space where F_x and F_y are defined. These basic criteria can be achieved by defining D as:

$$D(F_x, F_y) = \int |F_x(t) - F_y(t)|^p \, d\mu(t) \tag{4}$$

In this formulation, D is the Riemann-Stieltjes integral, with respect to function μ, of the absolute difference between the marginal CDFs, and where this difference is raised to the power p (it is assumed that $p \geq 1$). This is a notion of distance between the involved marginal risks. Notice also D is a positive transformation of the distance between these CDF functions based on the familiar L^p norm. For that reason, it is immediate to see D is minimized if and only if $F_x = F_y$ (with $D = 0$).

Three elements characterize ex ante motives in this formulation: the absolute value inside the integration sign, the exponent p, and the function μ. The absolute value in this equation assumes a symmetric discount for inequality. By changing this absolute value for a redirected or asymmetric absolute value we achieve a lop-sided inequality discount. This generalizes the notion of asymmetric inequality discount proposed in Fehr and Schmidt (1999). The exponent p captures a more subtle component of ex ante motives related to how much one values giving *at least some* chance to the other side. For example, by setting $p = 1$, the ex ante discount associated with these two lotteries $\frac{1}{2}(1,0) \oplus \frac{1}{2}(1,2)$ and $1(1,0) \oplus 0(1,2)$ is the same. When $p > 1$, instead, the former exhibits a smaller ex ante discount than the l.[16] The function μ allows for the incorporation of *decreasing marginal utility*. For example, when $\mu(t) = t$, displacing the same pair of unequal marginal risks to

[16] This assumes $\mu(t) = t$, for simplicity.

the right will maintain the same ex ante discount D. But this will be unreasonable if the ex post component $g(x,y)$ exhibits decreasing marginal utility because the displacement will make ex ante forces unreasonably larger relative to the ex post ones. By setting the $\mu(t) \neq t$ and making it compatible with the curvature of g, we can guarantee risk displacements will not exacerbate ex ante motives unreasonably. In the next subsection, by means of two examples, I show how the asymmetric discount (example 1) and the function μ (example 2) operate.[17]

Importantly, D generalizes familiar measures of inequality discount. Take for example $p = 2$ and $\mu(t) = t$. If L is a degenerate lottery at $(\bar{x}, \bar{y})$, D becomes simply the absolute distance between x and y: $D = |\bar{x} - \bar{y}|$. That is, D becomes a simple measure of inequality that shows up in standard models of inequity aversion. In particular, assuming the formulation in equation (3), deterministic preferences are fully given by some $u(x,y) = g(x,y) - \delta D(x,y)$, since W in such case will be an order-preserving transformation.

The function $g(x,y)$ also determines whether these preferences present ex post fairness or not. As will be formally stated in subsection 3.2, when g presents a form of supermodularity (a formal expression of *inequality aversion*) the model yields ex post fairness behavior.

To summarize, when the model consists of equations (3), (4) and a standard concave function g, it presents the following relevant properties: First, it behaves as a standard social preferences model in absence of risks. Second, if $\delta > 0$, there always exist two outcomes A and B such that the decision maker prefers a non-trivial lottery between these two outcomes rather than either outcome for sure. In other words, the model presents ex ante fairness, as desired. Further, this model is able to introduce ex ante motives at the modeling cost of one single additional parameter (δ), although it could also accommodate more flexibility from the exponent p. Third, attitudes towards fair-risks can be independent from deterministic preferences for giving as well as from ex ante fairness motives. Fourth, if g presents inequity aversion, the model exhibits ex post fairness behavior. Finally, this model satisfies the corresponding extension of Karni and Safra (2002) axiom of *fairness independence* that requires behavior to conform to the *expected utility theory* within

[17] I use $p = 2$ in all examples.

the set of fairness procedures (in our environment, the set of lotteries that make $F_X = F_Y$).

Because of the familiarity of the proposed D (in equation 4) with the $L^p - norm$, I call my model the *LP model*.

Examples

These two examples show how model extends previous deterministic other-regarding preferences to risky environments while incorporating ex ante motives (and, in the second example, risk attitudes as well).

Example 1: Extending Fehr and Schmidt (1999) with ex ante fairness.– Consider the following utility:

$$U(L) = \mathbb{E}\left[x - (1-\delta)d(x,y) - \delta D(F_x, F_y)\right] \tag{5}$$

where

$$D(F_x, F_y) = \int \alpha(F_x - F_y)_+^2 + \beta(F_y - F_x)_+^2 dt \tag{6}$$

and

$$d(x,y) = \alpha(y-x)_+^2 + \beta(x-y)_+^2 \tag{7}$$

To economize, I use: $(z)_+ = \max\{0, z\}$. In this formulation, we have set $W = g - \delta D$, $g = x - (1-\delta)\, d(x,y)$ with respect to equation (2), and $d\mu = dt$. The relative strength of ex ante motives is captured by δ. The functional D in this example is a lopsided norm with the same parameters as the regular F&S model. In absence of risks $D(x,y)$ becomes simply $d(x,y)$ and the whole model collapses to the standard Fehr and Schmidt (1999) utility. This model exhibits ex ante behavior as desired: For example, assuming $\alpha = \beta = \frac{1}{2}$, and setting $A = (1,0)$ and $B = (1,2)$, we have that a 50-50 lottery over A and B is strictly preferred to either A or B. Figure 3 shows how D extends the F&S inequality discount d to the lottery space. Depicted in red, we have the DM's marginal CDF and, in blue, the counterpart's. The left panel, the case with no risk, shows how standard deterministic inequality discount works as in the F&S model. The right panel shows how D extends this inequality aversion to the lottery space.[18]

Example 2: *Extending Andreoni and Miller (2002) with inequality aversion, ex ante fairness and risk attitudes.*– Consider the following utility:

$$U(L) = \gamma^{-1}\mathbb{E}\left[ax^\rho + (1-a)y^\rho - \theta\left((1-\delta)\,d + \delta\,D\right)\right]^{\frac{\gamma}{\rho}} \tag{8}$$

where

$$D(F_x, F_y) = \int |F_{x^\rho} - F_{y^\rho}|^2 dt \tag{9}$$

and

$$d(x,y) = |x^\rho - y^\rho| \tag{10}$$

Here, F_x is the marginal CDF of x within lottery L, and F_{x^ρ} is the marginal CDF of x^ρ (similarly for y). Notice that another way to express the ex ante discount is this: $D = \int |F_x(t) - F_y(t)|^2 d\mu(t)$, with $\mu = t^\rho$. This shows how function μ operates in equation (4).

Parameters a, ρ and θ fully describe deterministic preferences among which θ is the weight given to *all* inequality concerns. Within these inequality concerns, d captures the discount for ex post inequality and D captures the discount for ex ante inequality. δ gives the relative weight of the latter. γ shapes attitudes towards perfectly fair-risks. For simplicity, I assume symmetric inequity aversion in this example. It can be seen that if lottery L guarantees perfect equality (i.e. there is risk but $Pr[X = Y] = 1$), then $d = D = 0$ and this function $U(L) = \mathbb{E}(\frac{x^\gamma}{\gamma})$ fully determines preferences towards fair-risks. On the other hand, in risk-free situations, we have that $D(F_x, F_y) = \int (F_{x^\rho} - F_{y^\rho})^2 dt = |\bar{x}^\rho - \bar{y}^\rho| = d(\bar{x}, \bar{y})$. Therefore, the deterministic instance of this model are given by:

$$U(x,y) = \min\left\{(a-\theta)x^\rho + (1-a+\theta)y^\rho\,,\,(a+\theta)x^\rho + (1-a-\theta)y^\rho\right\}^{1/\rho} \tag{11}$$

This utility models preferences with altruism that is responsive to the price of giv-

[18] In this particular case, the graph represents ex ante motives in the particular case in which the two fixed outcomes are symmetric: A=(x,y) and B=(y,x) where $x \neq y$.

ing, as documented in Andreoni and Miller (2002) and in Fisman et al. (2007), and also with inequality aversion when $\theta > 0$ which generates the corresponding kink along the 45 degree line. The deterministic case where there is no inequality aversion (i.e. $\theta = 0$) makes this utility simplify to the original Andreoni and Miller (2002) model of altruism with *constant elasticity of substitution* (CES).

3.1 The Expected Inequality Aversion Model

In this subsection, I briefly discuss the Expected Inequality Aversion (EIA) model (Fudenberg and Levine 2012; Saito 2013) and a more general version that I refer to as the Generalized EIA (GEIA) model. The utility function in the EIA model is given by:

$$U(L) = \delta_s u(\mathbb{E}[x,y]) + (1-\delta_s)\mathbb{E}[u(x,y)] \tag{12}$$

where u is the classic F&S utility: $u = x - \alpha(y-x)_+ - \beta(x-y)_+$. Fudenberg and Levine (2012) and Saito (2013) argue that the first term of the RHS of this equation captures the ex ante motives and the second term the ex post motives. In this model δ_s indicates the relative strength of ex ante fairness concerns. What I refer to as the *Generalized Expected Inequity Aversion* (GEIA) model, has the same formulation of equation (12) except the F&S utility is replaced by a generic social preference utility $u(.)$, with the condition that $u(.)$ must be concave in each argument and along the 45 degree line. The concavity condition rules out both: risk loving behavior and non-convex deterministic preferences for giving. The concavity along the 45 degree line captures the aversion to risks that are egalitarian in ex post sense. One important virtue of the GEIA model is that it extends existing other-regarding models to incorporate ex ante motives using only the first moment, the expectation. Furthermore, it does so at the modeling cost of one single additional parameter. The reason why I want to focus on the GEIA formulation and not on its simpler EIA version is because the latter yields some unreasonable predictions that can be easily corrected precisely by replacing the F&S utility with a concave utility. For example, in the EIA model, the piece-wise linearity of the F&S utility implies that in riskless situations the DM is (a.e.) unresponsive to the price of giving, and that attitudes towards perfectly fair risks are neutral.[19] The GEIA solves those minor issues but keeps its core tenet: that *people exhibit ex ante fairness behavior because they partly assess and compare their expected outcomes with others'*. This postulate directly implies these two testable predictions: (i) tolerance to risks increases with ex ante fairness motives, and (ii) highly ex ante fairness oriented individuals disregard differences in risk correlation. Additionally, also testable, the GEIA model does not conform to the expected utility theory even regarding perfectly fair risks. That is, it does not satisfy Karni and Safra's axiom of *fairness independence*.

Because my model differs from the GEIA in all these predictions, one of the objectives of the experimental exercise is to test such implications. In subsection 3.2, I present these implications formally.

3.2 Empirical Predictions

In this section, I present the implications that describe the main behavioral patterns predicted by the LP model. I also present some propositions with predictions that are exclusive to the GEIA model. Later, in the empirical part of the paper (sections 4 and 5), I test these implications with data from a laboratory experiment.

In what follows, for simplicity, I assume $X = \Re^2_+$ and the formulation of the model that is given in equation (3) with W linear, $\mu(t) = t$, and $p > 1$. Also, I assume that deterministic preferences are positively monotonic in both x and y.

Let me first state the predictions about ex post fairness behavior. Consider lotteries L^{fair} and L^{unfair} to depend on a choice variable α:

1. $L^{fair}(\alpha) = \frac{1}{2}(\alpha\bar{Z}, \alpha\bar{Z}) \oplus \frac{1}{2}((1-\alpha)\underline{Z}, (1-\alpha)\underline{Z})$ and,
2. $L^{unfair}(\alpha) = \frac{1}{2}(\alpha\bar{Z}, (1-\alpha)\underline{Z}) \oplus \frac{1}{2}((1-\alpha)\underline{Z}, \alpha\bar{Z})$

where $\bar{Z} > \underline{Z}$. Notice that both lotteries make outcomes for the *DM* and her counterpart perfectly correlated. In L^{fair} this correlation is positive and in L^{unfair} it is negative. Consider also the following choice problem:

$$\max_{\alpha \in [0,1]} U(L(\alpha)) \tag{13}$$

[19] See López-Vargas (2014) for a detailed comment o n the EIA model.

When this choice problem is over fair risks ($L^{fair}(\alpha)$), the decision consists of balancing risks and returns according to DM's preferences. When, instead, this problem is over unfair risks ($L^{unfair}(\alpha)$), the decision necessarily incorporates DM's fairness considerations as well, because ex post outcomes are always unfair in such a decision problem. Notice that in this context α is a measure of risk tolerance. The *personal* expected value in either lottery is $\mathbb{E}x = \mathbb{E}y = 0.5\,(\alpha\bar{Z} + (1-\alpha)\underline{Z}) = 0.5\,(\underline{Z} + \alpha(\bar{Z} - \underline{Z}))$. Therefore, if the DM tolerates risk perfectly she will choose $\alpha = 1$. If, instead, she behaves with extreme risk aversion, she will choose making sure this equality holds $\alpha\bar{Z} = (1-\alpha)\,\underline{Z}$ by choosing $\alpha = \alpha^{safe} \equiv (1+\underline{Z}/\bar{Z})^{-1} < 1$.[20] I define α^{fair*} as the solution to problem (13) when $L(\alpha) = L^{fair}(\alpha)$, and $\alpha^{unfair*}$ as the solution when $L(\alpha) = L^{unfair}(\alpha)$.

For Proposition 1, I also need to define the property of supermodularity.

Definition $g : X \to \Re$ is (*strictly*) *supermodular* with respect to $z, z' \in X$, if $g(z \uparrow z') + g(z \downarrow z') \geq (>)\, g(z) + g(z')$ where $z \uparrow z'$ denotes the component wise maximum and $z \downarrow z'$ the componentwise minimum of z and z'. We say g is *globally* supermodular if it is supermodular with respect to any $z, z' \in X$.

The supermodularity assumption that will be imposed on g is a formal expression of inequality aversion.[21] Intuitively, it states that the incremental utility associated to an positive change in DM's resources (x) is bigger if such a change in x improves equality compared to when it hurts equality. Proposition 1, formally states that this weak form of inequality aversion implies ex post fairness behavior.

Proposition 1 (ex post fairness) In the LP model, if g is (i) globally supermodular, and (ii) strictly supermodular with respect to any two outcomes $A = (x_A, y_A)$ and $B = (x_B, y_B)$ with $y_A > x_A$ and $x_B > y_B$, then the optimal risk tolerance to fair lotteries is higher than to unfair lotteries: $\alpha^{fair*} > \alpha^{unfair*}$.

Proof in the Appendix.

Notice that α is directly observable from choice problems like the one in expression (13), so this proposition can be empirically tested.

[20] Any choice below α^{safe} is irrational.

[21] All standard models of inequity aversion satisfy this property.

Next, I state the predictions about ex ante fairness behavior. Let $L(p,A,B)$ denote a lottery over outcomes A and B where p is the probability of A:

$$L(p,A,B) = p\,(x_A, y_A) \oplus (1-p)\,(x_B, y_B) \tag{14}$$

Without loss of generality, I will assume for the rest of this subsection that A and B satisfy $y_A > y_B$ and $x_B > x_A$. That is, A and B are undominated and A is disadvantageous relative to B in terms of the DM's resource. Consider now this choice problem:

$$\max_{p\in[0,1]} U(L(p,A,B)). \tag{15}$$

Define p^* to be the solution to this problem. This is the choice problem where DM chooses or not to *share chances* with others and, if $p*$ is a non-trivial probability, we say DM exhibits ex ante fairness seeking behavior.

Proposition 2 (ex ante fairness) In the LP model, if $\delta > 0$, then there exist two outcomes A and B in X such that the corresponding optimal $p*$ satisfies: (i) $p^* \in (0,1)$, and (ii) for low enough δ, p^* is increasing in x_A, y_A and decreasing in x_B, y_B.

Proof in the Appendix.

Proposition 2 states formally that the *LP* model exhibits ex ante fairness behavior that manifests in DM's preferences for *sharing chances* with her counterpart. Furthermore, the proposition states that when ex ante forces are present but are not predominant (δ is positive but low enough) *DM* will react to the attractiveness of (the relatively disadvantageous) outcome A.

Next, I state propositions describing the behavioral predictions of the GEIA model. The core implications of the GEIA model are: (i) risk tolerance correlates positively with ex ante fairness behavior, and (ii) ex post and ex ante fairness concerns trade-off in behavior. Propositions 3 and 4 state these implications formally, and the following discussion provides their intuition and the kind of test we can implement about them with observed behavior.

Proposition 3: In the GEIA model, the optimal tolerance to fair risks, α^{fair*} in problem in expression (13), is increasing in the ex ante motives δ_s.

Proof in the Appendix.

Proposition 4: In the GEIA model, the ex post fairness observable measure, $\alpha^{fair*} - \alpha^{unfair*}$, converges to 0 as δ_s goes to 1.

Proof in the Appendix.[22]

These propositions describe how, in the GEIA model, risk taking behavior is affected by the ex ante fairness parameter δ_s. Intuitively, Proposition 3 simply says that the higher is the weight (δ_s) of $u(\mathbb{E}x, \mathbb{E}y)$ in the GEIA utility, the less responsive to risks the DM becomes.

Importantly, while risk attitudes are observable through chosen$\alpha's$ in decisions like the one problem (13), δ_s is not directly observable. For this reason, in Proposition 5, I establish how the parameter δ_s of the GEIA model can be approximated from observed behavior. To see how Proposition 5 operates, I need to define a new choice problem. As in problem (15), consider two outcomes A and B, and, without loss of generality, let me assume $B \succ A$. Next, I define the following *deterministic* choice problem:

$$\max_{s \in [0,1]} U(sx_A + (1-s)x_B\,,\, sy_A + (1-s)y_B) \tag{16}$$

where s is the weight given to outcome A in the convex combination between A and B. Let $s*$ be the solution to such problem. Notice that problem (16) is a general way to express the standard deterministic Dictator Game. To see how I use choice problems like the ones in expressions (15) and (16) to approximate δ_s, consider the simple case where $A = (0,a)$, $B = (b,0)$. Notice that in the GEIA model, a perfectly ex-ante motivated decision maker ($\delta_s = 1$) will assess any lottery $L(p,A,B)$ only by its expected values – i.e. by looking at $U(L(p,A,B))= u(\mathbb{E}x, \mathbb{E}y)=u(px_A + (1-p)x_B\,,\, py_A + (1-p)y_B)$. Therefore, for such a decision maker choosing p in problem (15) and choosing s in problem (16) are actually the

[22]It is important to note that if u satisfies inequity aversion, captured by the same supermodularity property I previously imposed on g, we have that $\alpha^{fair*} > \alpha^{unfair*}$, as in the LP model. Therefore, in such case, $\alpha^{fair*} - \alpha^{unfair*}$ is on average decreasing in δ_s.

same decision, and so they have the same solution: $p* = s*$. Suppose instead the decision maker is perfectly ex post driven in the GEIA model ($\delta_s = 0$). In such case, $U(L(p,A,B)) = \mathbb{E}u(x,y) = pu(x_A,y_A) + (1-p)u(x_B,y_B)$ and therefore $p* = 0$ as I assumed $B \succ A$. In the in between case ($0 < \delta_s < 1$), and for A and B such that $s* > 0$, we have that $p* < s*$ and that $p*$ increases with δ_s. For that reason, the observable measure $\hat{\delta}_s = p*/s*$ is a proxy of δ_s. Proposition 5 states this formally.

Proposition 5: In the GEIA model, $p*$, the solution to problem in expression (15), satisfies:

(i) $p*$ is weakly increasing in δ_s, and

(ii) $p* \in [0, s*]$.

Proof in the Appendix.

With the proxy $\hat{\delta}_s$, I can test Proposition 3, the core implication of the GEIA model regarding how risk attitudes are affected by ex ante motives (δ_s). To see how this test works intuitively, consider again the simple case of $\delta_s = 1$. Such a decision maker will always choose $p* = s*$, and, because her utility is $U(L) = u(\mathbb{E}x, \mathbb{E}y)$, she will also choose always $\alpha^{*fair} = 1$. Therefore, individuals that behave as strongly or perfectly ex ante fairness driven ($p*$=$s*$), but at the same time avoid risks to some degree ($\alpha^{fair*} < 1$), are inconsistent with the GEIA model. Furthermore, this test of the GEIA model does not restrict to individuals that exhibit $p* = s*$. Suppose two individuals have the same deterministic preferences u (that can be elicited via decisions in deterministic Dictator Games) and so they both choose the same $s*$, always. Suppose also that, compared to individual 2, individual 1 chooses $p*$ (in problem 15) closer to $s*$. This can only mean that he has a higher δ_s and so, by the utility of the GEIA model (equation 12), he must tolerate fair risks more than individual 2: $\alpha_1^{fair*} > \alpha_2^{fair*}$. The empirical analogue of Proposition 3 is then that α^{fair*}must correlate with $\hat{\delta}_s$ once we control for deterministic choices. This will be one of the hypotheses I test with experimental data.

4 Experiment

In this section, I present evidence from a laboratory experiment designed to jointly study other-regarding preferences (ex ante and ex post fairness concerns, in particular) and attitudes towards risks in a social setup. I focus on studying the empirical correlate of the propositions in Section 3.2 that described the choice pattern of ex post and ex ante fairness in the LP model, as well as how risk attitudes interact with fairness motives in the GEIA model.

4.1 Design

Individuals in the experiment performed decisions in four different types of tasks. There were eleven decision rounds for each task type. The experimental protocol and the interface in which subjects made all decisions are described in the *procedures* subsection.

Task type 1 – sharing in chances.- This decision environment elicits ex ante motives. Each decision problem of this type gives *decider* two fixed, mutually exclusive (undominated) outcomes e.g. $A = (0,90)$ and $B = (90,0)$. Subjects are then asked to allocate probabilities between the two outcomes. Formally, for two given outcomes (x_A, y_A) and (x_B, y_B), each decider was asked to choose $p \in [0,1]$ to form his preferred lottery $L(p*)$ from this set $\{p\,(x_A, y_A) \oplus (1-p)\,(x_B, y_B) \,:\, p \in [0,1]\}$. Each decision round had a different pair of fixed outcomes A and B. The full list of specific choices presented to subjects is reported in the first column of 1.

Task type 2 – taking fair-risks.- This task elicit risk attitudes free from fairness concerns. In each choice of this task, subjects decide how much risk to bear in a two-state contingent commodity environment, with the feature that either state of the world (A or B) pays the same amount of money to decider and her counterpart (i.e. risks are perfectly positively correlated across agents). The probability of each state is given and subjects are informed about it. Formally, given p_A, each subject was asked to choose a lottery $L(\alpha)$ from this set: $\{p_A\,(\alpha\bar{Z}, \alpha\bar{Z}) \oplus (1-p_A)\,((1-\alpha)\underline{Z}, (1-\alpha)\underline{Z})\}_{\alpha\in[0,1]}$, where $\bar{Z}$ and $\underline{Z}$ denote the maximum total payoff that each agent could potentially obtain in State A and State B, respectively. I am assuming here that state A has always the highest expected return. In the actual experiment, across choices, the higher return varied from A to B randomly. Each of the eleven decision rounds had a different pair of fixed $\bar{Z}$ and $\underline{Z}$. Six decisions used $p_A = 0.5$, $\bar{Z} \neq \underline{Z}$, three decisions used $p_A \neq 0.5$, $\bar{Z} = \underline{Z}$, and two decisions used $p_A = 0.5$, $\bar{Z} = \underline{Z}$. The full list of specific choices presented to subjects is reported in the first column of 2.

Notice that this choice problem can be interpreted as a two-state environment with two securities or claims (one for each state). Each security pays one token to each agent if the corresponding state is realized. Furthermore, each subject is given a budget and face potentially different relative prices for securities A and B (or *state prices*). If, for example, the given budget is $\bar{Z}$, and price of B-security is 1, then the price of A-security is $\underline{Z}/\bar{Z}$, and the quantities of A-securities and B-securities that are acquired are $\alpha\bar{Z}$ and $(1-\alpha)\underline{Z}$, respectively.

Task type 3 – taking unfair-risks.- This task elicits attitudes towards risks with unfair outcomes. Similar to task 2, subjects decide how much risk to bear in a two-state contingent commodity environment. However, in this task, either state of the world (A or B) pays are unequally to decider and counterpart, unless no risk is chosen to be borne. In fact, marginal risks are perfectly negatively correlated. The probability of each state is given and subjects are informed about it. Formally, given p_A, each subject was asked to choose a lottery $L(\alpha)$ from this set: $\{p_A\,(\alpha\bar{Z}, (1-\alpha)\underline{Z}) \oplus (1-p_A)\,((1-\alpha)\underline{Z}, \alpha\bar{Z})\}_{\alpha\in[0,1]}$, where $\bar{Z}$ and $\underline{Z}$ denote the maximum total payoff that the decider (partner) could potentially obtain in State A (B) and State B (A), respectively. Each of the eleven decision rounds had a different pair of fixed $\bar{Z}$ and $\underline{Z}$. Six decisions used $p_A = 0.5$, $\bar{Z} \neq \underline{Z}$, three decisions used $p_A \neq 0.5$, $\bar{Z} = \underline{Z}$, and two decisions used $p_A = 0.5$, $\bar{Z} = \underline{Z}$. As in task type 2, marginal risks are the same between decider and her counterpart. The full list of specific choices presented to subjects is reported in the first column of 2.

Task type 4 – deterministic giving.- It is the standard *riskless giving* decision environment where deterministic other-regarding preferences are elicited in a standard dictator-like game varying the budget and the price of *giving*. Formally, a subject was asked to choose y to form an allocation (x,y) from those satisfying the constraint: $qy + x = M$. Across rounds, the price of giving q and the size of the budget M varied. The full list of specific choices presented to subjects is reported in the first column of 3.

4.2 Hypotheses

Hypothesis 1 (Ex post fairness): Tolerance to fair-risks (α^{fair}'s from tasks 2) is higher than tolerance to unfair-risks (α^{unfair}'s from tasks 3).

This hypothesis states the prediction of Proposition 1.

Hypothesis 2A (Ex ante fairness): Subjects exhibit ex ante fairness behavior: they commonly choose non trivial probabilities, $p \in (0,1)$, in tasks of type 1.

Hypothesis 2B (Ex ante fairness): Ex ante fairness behavior (probabilities p chosen in tasks of type 1) respond positively to the relative benefits of helping a partner. That is, p is increasing in $\frac{y_A - y_B}{x_B - x_A}$.

Together, these two hypotheses state the predictions of Proposition 2. While existing evidence already indicates ex ante fairness is a common behavior, and so Hypothesis 2A is backed by evidence, further characterization of how individuals trade-off this motive with other motives – like the one stated in Hypothesis 2B – has not been studied in detail.

Hypothesis 3 (GEIA - ex ante vs risk tolerance): Tolerance to fair risks (α from tasks 2) correlates positively with ex ante fairness seeking behavior (choices from task 1 and the proxy of δ_s).

This hypothesis provides the empirical test of Proposition 3, where δ_s is approximated following the result in Proposition 5.

Hypothesis 4 (GEIA - ex post vs ex ante): The measure of ex post fairness, $\alpha^{fair} - \alpha^{unfair}$ (from tasks 2 and 3) decreases with stronger ex ante fairness seeking behavior (choices from task 1 and the proxy of δ_s).

This hypothesis provides the empirical test of Proposition 4, where δ_s is approximated following the result in Proposition 5.

4.3 Procedures

Interface:
The experiment used a graphical interface for all decisions. Tasks of type 1 were presented as shown in Figure 4. In such a screen, deciders are informed about the two outcomes (in tokens) by means of a graph and a . They were then asked to use a *slider tool* to choose the probability of allocation (x_A, y_A). Tasks of types 2 and 3 were presented as shown in Figures 5 and 6. In such screens, deciders are informed about the odds of each state (in percentage terms). They were then asked to drag with the mouse the shapes that determine the lottery for herself (blue square) and for her counterpart (orange circle). Tasks of type 4 are the standard Dictator Game, shown in Figure 7. Interface design for tasks 1 is novel. Interface design for tasks 2-4 are similar to those used in Choi et al. (2007) and Fisman et al. (2007).

Sessions and Protocol:
The experiment was run at the Experimental Economics Laboratory at the University of Maryland (EEL-UMD). The program was coded in z-Tree (Fischbacher, 2007). For a total of 7 sessions, 110 undergraduate students were recruited via EEL-UMD's online recruitment system. A session took about 60 minutes, in which every subject was asked to make choices in a series of decision rounds. At the start of a session, pairs were formed by anonymous matching. In a pair, one subject was assigned to the role of *decider* and the other subject was assigned to the role of *partner*. Both pairing and role assignment were done randomly, and they remained fixed for the entire session. Subjects were informed of their role at the start of the

interaction, before any decision was made. For each pair, both the decider and partner were posed the same decision problems, however, only the choices made by the decider determined the payoffs.

The order in which tasks were presented within a session was randomized to eliminate order effects. Also, for each task, subjects were posed eleven decision problems ("decision rounds"). The order in which each round appeared was also randomized. At the end of the session, subjects were paid according to one randomly selected decision made by the decider plus a fixed participation fee of 5 USD. Exchange rate was 1 USD for every 5 experimental tokens.

5 Results and Discussion

Result 1 (Ex post fairness): Ex post fairness considerations affect risk taking behavior. In particular, tolerance to ex post fair risks is higher compared to tolerance to ex post unfair risks (Hypothesis 1).

I test hypothesis 1 in two different ways. First, I compute the responsiveness of the ratio x_A/x_B to the relative expected price of securities A and B: $R = \frac{Pr[B]\, I_B}{Pr[A]\, I_A}$. We know from standard expected utility theory that a perfectly risk neutral subject will make choices that secure $x_A/x_B = 1$, regardless of how R changes. However, if the subject is risk tolerant, she will be very responsive to changes in R. In Table 4 (columns 1 and 2), I report the regression of $log\left(\frac{x_A}{x_B}\right)$ on $log(R)$. To test the difference in risk taking behavior, I include an interaction between $log\,(R)$ and the dummy variable indicating task of type 4 (unfair risks). Individual random effects as well as session effects are included in the regression. The estimated coefficient of $log\,(R)$ is 1.3028 and the coefficient of the interaction is 0.4346 (both statistically greater than zero with p<0.01). From this estimation, we can conduct the following exercise that shows how the risk taking behavior is very distinct between tasks 3 and 4. Suppose we *incorrectly* assume that: (i) risk attitudes are unrelated to ex post fairness considerations, and (ii) risk preferences take the form or a CRRA utility. If under these assumptions we proceed to estimate the Arrow-Pratt measure of relative risk aversion, the corresponding coefficients for tasks 3 and 4, would be 0.7675 (s.e.=0.0629) and 1.1518 (s.e=0.1543), respectively. The difference is statistically different than zero (p=0.007). Furthermore, this difference of approximately 0.4 points in this measure of risk aversion is important relative to the dispersion we observe in other empirical work which is at least 0.3 in most studies.

I also test this hypothesis using the corresponding observed α's from the choice problem (13). Recall that $\alpha \in [0,1]$ is the proportion of the budget that is allocated to the high return asset and it is a measure of risk tolerance. However, since choosing α below the perfectly safe value is irrational, I normalized α's by the safe choice. Formally, if I_A and I_B represent the intercepts of the budget line with the axes for State A and B, respectively, then our risk tolerance measure is:

$$\hat{\alpha} = \frac{z_{high} - Safe}{\bar{Z} - Safe} \tag{17}$$

where z_{high} is the amount of high-return security chosen by the decider, $\bar{Z} = \max\{I_A, I_B\}$ and:

$$Safe = \left(\frac{1}{I_A} + \frac{1}{I_B}\right)^{-1} \tag{18}$$

If $\hat{\alpha} = 0$ every time $I_A \neq I_B$, then DM is perfectly risk averse. If instead $\hat{\alpha} = 1$, always then she is (highly) risk neutral. Consider this example to see how $\hat{\alpha}$ is a measure of tolerance to uncertainty. Suppose $I_A = 6$ and $I_B = 3$. By equation (18), $safe = 2$. If, for example, DM takes a big risk and chooses 5 units for state A and only 0.5 units for State B (i.e. $z_{high} = 5$). Then $\hat{\alpha} = \frac{5-2}{6-2} = 0.75$. If, instead, DM chooses a more conservative $z_{high} = 2.1$, then $\hat{\alpha} = 0.025$. I use this measure to study how risk taking varies between tasks 2 and tasks 3, although in the actual regression this measure is rescaled to take values from 0 to 100. Table 4, column 3, reports on a simple regression of individual $\hat{\alpha}$ on the dummy that takes value of 1 for ex post unfair risks (tasks of type 3) and 0 for ex post fair risk (tasks of type 4). On average, $\hat{\alpha}$'s from the unfair task are 14.8 points lower than for the ex post fair tasks. As in the case of the responsiveness of x_A/x_B this regression includes individual as well as session effects.

As robustness check, I conducted similar analyzes considering only α's from decision rounds that shared the same I_A and I_B. The same result holds.

Result 2 (Ex ante fairness): Helping partners probabilistically – i.e. exhibiting ex ante fairness behavior – is a common behavioral pattern (Hypothesis 2A). Furthermore, this conduct responds to the relative benefits of helping a partner. This is, if A is Decider's comparatively disadvantageous outcome, chosen p_A^* is increasing in the relative benefits of A over B: $\frac{y_A - y_B}{x_B - x_A}$ (Hypothesis 2B).

This result utilizes only choices from tasks of type 1 (*sharing in chances*). Choices from these tasks confirm that ex ante fairness concerns are an active force in these environments. Considering only choices involving undominated outcomes (first 10 rows of Table 1), subjects assigned a positive probability to the disadvantageous outcome in 46% of all choices. Further, 40 out of 55 deciding subjects (72%) gave a positive probability to the disadvantageous outcome in at least one choice of this task.

The second part of Result 2, is reported in Table 1. The first column of this table describes each decision round of this task by stating the two outcomes A and B.[23] The second column indicates the substitution rate of expected values, $\frac{y_A - y_B}{x_B - x_A}$. That is, *how much partner's expected dollars increase when decider gives up one expected dollar*; which is a broad measure of the benefits achieved by each (expected) dollar decider sacrifices to help the other. The third column indicates the average probability deciders gave to outcome A. In this table, outcome A is always the more advantageous to the partner relative to the decider and outcome B.[24] Also, all up to row 8, this table is sorted by this substitution rate.

With this information, we can see that subjects, on average, responded strongly to the relative benefit of sharing in probabilities. When giving up one expected dollar implied only a 0.43 increase in partner's expected dollars, deciders gave to outcome A a probability of only 11.1% (1st row). When instead the relative benefit was 2.33, the probability of outcome A went up to 28%, on average (8th row of the table). This difference is statistically significant (p-value<0.01). Rows 3-6 of this

[23] E.g. "A:(10,60); B:(80,30)" means: if outcome A realizes, Decider gets 10 tokens and Partner gets 60. And if outcome B realizes Decider gets 80 tokens and Partner gets 30.

[24] In the experiment outcomes labels were allocated randomly.

table shows choices where the relative incentive to share chances (in column 2) is constant and always 1. Instead, across these choices, the experimental design varied the degree of risk. Data shows subjects shared more chances when the was less risk involved. For this kind of choice, when A:(0,90); B:(90,0), subjects shared on average only 17.5% (row 3). However, when facing outcomes A:(30,60) and B:(60,30) they shared 22.9% (row 6). The latter being statistically higher (p-value<0.05). Interestingly as well, comparing rows 9 and 10 of the same table, we observe subjects shared substantially more chances if helping others also involved increasing the odds of a perfectly fair outcome (row 10 – 32.8%) as opposed to when it involved moving away from it (row 9 – 10.33%). This pattern of behavior is also summarized in a regression reported in Table 5. In this analysis we can observe that, on average, increasing the relative attractiveness of outcome A in one full unit (e.g from 1 to 2) is associated with giving 15% additional chances to such an outcome. This direction and strength of the response, as discussed in Proposition 2, indicates that the ex post forces are stronger than ex ante ones. To see why, consider the following example. Suppose a person is to decide the probabilities of two mutually exclusive outcomes A and B, with A:(0,10) and B:(10,0). If she is only motivated by ex ante fairness forces, she is likely to choose $Pr[A] = 0.5$. But what would this decision maker choose if A is replaced by $A' = (0, 15)$? From her purely ex ante fairness perspective, given that A' is asymmetrically advantageous to her partner (relative to B), she will compensate this asymmetry by choosing $Pr[A'] < 0.5$. Ex post forces operate in the opposite direction. If the decision maker prefers A' over A ($A' \succ A$), this necessarily implies that she will be more inclined to give higher chances to A' than what she gave to A. That is, if ex post forces prevail we would observe that $Pr[A'] > Pr[A]$. Because this is exactly the choice pattern we observe, we conclude ex post forces are stronger than ex ante ones in this context.

The last choice reported in this table is a rationality check. Outcomes for this choice are A:(30,30) and B:(60,60) implying that rational subjects can only choose Prob[A]=0. We instead find that 11 subjects assigned a positive probability. Although on average this probability is 8.9%, it is mostly driven by five subjects that gave 50%. This result is somewhat striking given how consistent and well behaved results are on average. One possible explanation is that because all ten of the other choices presented undominated outcomes, some strongly ex ante fairness oriented subjects might have mixed this choice with the one involving outcomes A:(30,60) and B:(60,30). Four of these five subjects gave 50% in both of these choice problems.

Result 3 (GEIA - risk tolerance vs ex ante fairness): Tolerance to fair-risks does not correlate positively to ex ante fairness seeking behavior as the GEIA model predicts.

To test Hypothesis 3, I conduct simple regression analyzes where the dependent variable is a measure of risk tolerance and the regressor is a proxy of δ_s, the (unobservable) strength of the ex ante fairness motives. Recall that, as expressed in Proposition 3, in the GEIA model (equation 12) higher weight on the ex ante fairness motives (δ_s) implied higher risk insensitivity. That is, this model prescribes that the more individuals seek ex ante fairness, the less responsive to risks they become. In my model, on the other hand, these two forces do not need to link.

As detailed in Proposition 5, although we do not directly observed δ_s, we can build a proxy using the comparison between what is *given* deterministically (s^* in choices of task 4; see decision problem 16) and what is given probabilistically (p^*in choices of type 1; see decision problem 15). The comparison is perfect when we consider a task with the same pie size and relative prices in either task. For example, I use the deterministic task with the constraint $x+y=90$; and the probabilistic task with outcomes $A:(0,90)$ $B:(90,0)$. The proxy for δ_s is then $\hat{\delta}_s = Pr[A]/s^*$. The results of the corresponding regressions are reported in Table 6, column 1. It can be observed that risk tolerance is not associated with higher ex ante fairness motives (proxy of δ_s).

Notice the proxy of δ_s I use has the undesirable property that if s*=0 for the specific choice that is being utilized, then the proxy is not defined even if the subject does have a positive δ_s. This is why I also conduct a series of robustness checks. First, in Table 6, column 2, I report on a less structured exercise where I do not use the built proxy of δ_s. Instead I directly use ex ante fairness behavior, i.e. probabilities allocated to relatively disadvantageous outcomes, and controlling for deterministic giving. The same results hold.

Finally, I conduct two extra robustness checks implementing similar regressions but using a larger set of choices from task 1, to account for the possibility that ex ante fairness might correlate with risk tolerance not exactly in the sense that the GEIA model predicts but in another way that is similar in nature – that is, if people look at process their ex ante fairness concerns by assessing expected payoffs. I find that there is no evidence linking ex ante fairness behavior with risk taking behavior. These extra checks can be found in tables 7 and 8, in the Appendix.

Result 4 (GEIA - ex post vs ex ante): Ex post fairness behavior does not correlate negatively with ex ante fairness behavior, regardless we control or not for deterministic preferences.

To test hypothesis 4, I run a regression where the dependent variable is $RTI_1^{fair} - RTI_1^{unfair}$ and the independent variable is the proxy of δ_s constructed for Result 3. Testing the hypothesis that the sign of the corresponding coefficient in this regression is negative is rejected ($p<0.05$).

From results 3 and 4, I conclude the following about the GEIA model. Although the GEIA model predicts ex ante fairness behavior, its core implications regarding how risk attitudes link to fairness behavior do not hold in observe behavior. I interpret this as evidence favoring my model since these results imply that a formulation of ex ante fairness solely based on first moments do not match the data.

Further Descriptive Results

Taking fair and unfair risks (task types 2 and 3)

Table 2 reports summary statistics from choices in tasks 2 and 3. The first column details the choice problem. For example, the first choice: "Pr[A]=50%; I_A=100; I_B=25" represents the choice problem where State A occurred with 50% probability and paid a maximum of 100 tokens and where State B pays a maximum of 25 tokens.[25] The second column shows the probability adjusted price of a State

[25] In notation from our propositions: $\bar{Z} = 100$ and $\underline{Z} = 25$ in this example.

A security relative to a State B security. In the first row of the table, for example, the price of A-security is 1/4 of the price of B security. The third and fourth columns show how many State A securities decider bough in choice problems of Tasks 2 and 3, respectively. The fifth column in this table shows what a perfectly risk averse agent would choose in each choice problem. Table 2 is sorted by the relative price (column 2) all up to the 9th row which includes choices with 50-50 States. We see in the behavior of all these 9 choice problems two stylized conducts. First, that subjects responded to the risk / return tension as standard theory predicts: when securities were priced the same, on average, no risk was taken. When one security offered a higher return than the other by having lower relative price, some risk was taken towards the high return security.

More importantly, exactly as Result 1 states, we can observed that every time there was a risk/return tension (all choices except choices in rows 5 and 6) deciders took more risk in Task 2 than in Task 3. We can observe that by realizing that in all such cases, the quantity of State A-securities of Task 3 is closer to the the perfectly risk averse (*safe*) choice of column 5.

Deterministic Giving (Task Type 4)

Table 3 the results of the deterministic giving task. The first column details the budget intercepts at Decider's axis (X) and at partner's (Y). The second column shows the relative price of giving: Py/Px. Columns 3 and 5 report the average amount in tokens deciders allocated to themselves ($\bar{X}$) and to partners ($\bar{Y}$), respectively. Column 7, reports the ratio $\bar{Y}/\bar{X}$. Again, on average, behavior in this tasks strongly conforms to standard consumer theory. When *giving sure dollars* is very cheap relative to *keeping* them, Py/Px=0.25, subjects give partners about 1.8 times what they keep for themselves. On the other side of the price range, if the price of giving relative to keeping is 4, subjects pass one tenth of what they keep (see last row of Table 3).

6 Conclusions and Research Agenda

My paper studies two important questions involving risk attitudes and other-regarding preferences. First, I asked whether or not risk attitudes are affected by the regard for others – and if so, how. Second, I asked how fairness concerns operate under uncertainty. In particular, what drives ex ante fairness. To answer these questions, I propose an integrated model of risk attitudes and social preferences. This model, which I name the LP model, extends the standard notion of inequality discount to lotteries assuming an individual makes a comparative assessment of the marginal risks she and others face. Following the intuition of ex post fairness, the LP model predicts a higher tolerance to risks with positively correlated outcomes compared to tolerance to risks with negatively correlated outcomes. Importantly, my model is capable of explaining ex ante fairness behavior manifested in people's preferences for helping others probabilistically. I also briefly present and study the core implications of the *expected inequality aversion (EIA)* model (Saito, 2013) that are at odds with my model.

I report on an experimental study of my model's predictions as well as of the distinctive implications of the EIA model. I find that social considerations impact risk attitudes: subjects take substantially more risks when outcomes were ex post fair compared to when they were ex post unfair. To the best of my knowledge, mine is the first lab experiment that precisely measures the impact on risk taking behavior of ex post fairness considerations. This result is important because previous experimental literature (Brennan et al., 2008; Bolton and Ockenfels, 2010; Rohde and Rohde, 2011) had claimed the impact of social considerations on risk attitudes was virtually null.

I also confirm ex ante fairness behavior is a common choice pattern and document how, according to the model, this motive responds to the attractiveness of the outcomes involved. Finally, I also studied the core implications of the EIA model concluding that, although this model is capable of explaining ex ante fairness behavior its predicted positive link between risk tolerance and ex ante fairness does not hold in observed behavior.

There are several directions in which the literature on this topic can expand. On the decision theory dimension, axiomatizing the model will allow a better theoretical contrast with the EIA model and with other models of ex ante fairness that have an axiomatic ground (in particular, Karni and Safra, 2002). In the empirical side, the experimental design and interface I introduce in this paper can be easily extended to incorporate a larger set of choices that would allow conducting individual analysis and study heterogeneity in the population.

In the application side, my model and experimental findings have important implications for our understanding of economic interactions that involve risks and that are prompt to social comparisons, calling for an extension of our current modeling approaches in such contexts. Think of a tournament, for example, where risk attitudes and fairness concerns have been studied separately and found to be important forces for behavior and achieved efficiency. My model offers a framework to study those two forces jointly, accounting for their interaction.

At a more aggregate level, my model sheds some light on how risk taking behavior might vary across the income distribution. In particular, it predicts that, other things constant, higher risk taking behavior will be observed among individuals at the tails of the distribution compared to individuals in the middle.

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Figures

Figure 1: Binary Decision (top) Vs. Sharing in Chances (bottom)

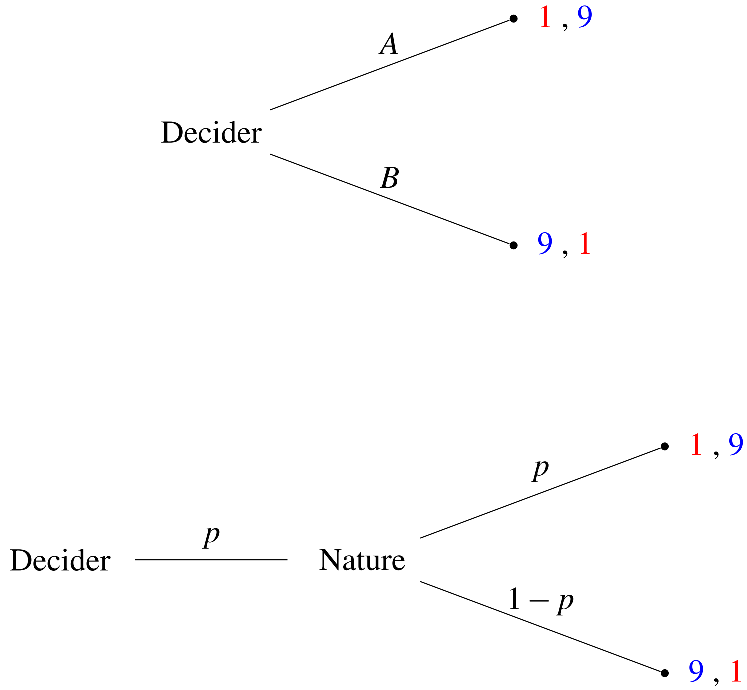


Figure 2: Fair-risk Taking (top) Vs. Unfair-risk Taking (bottom)

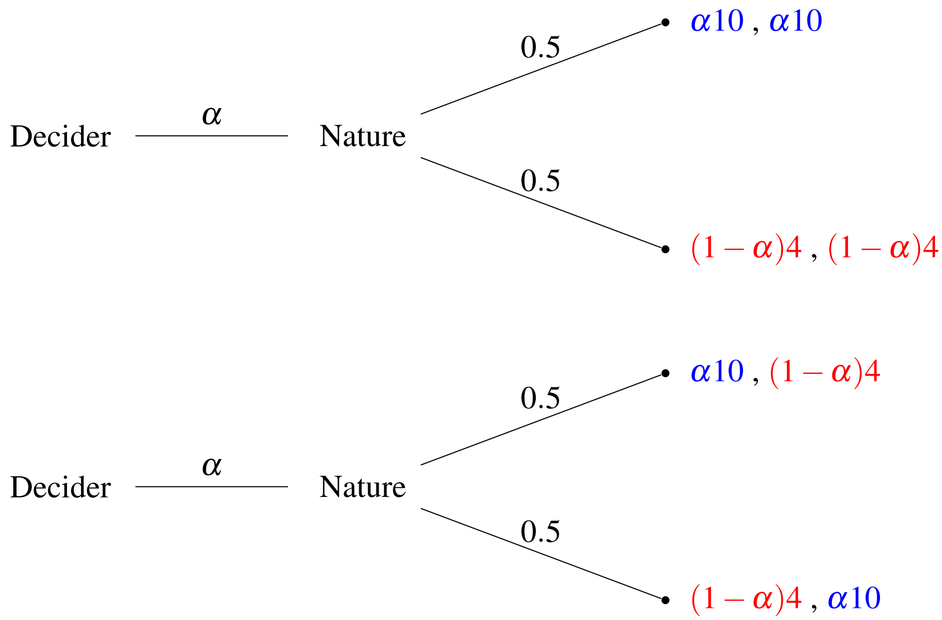
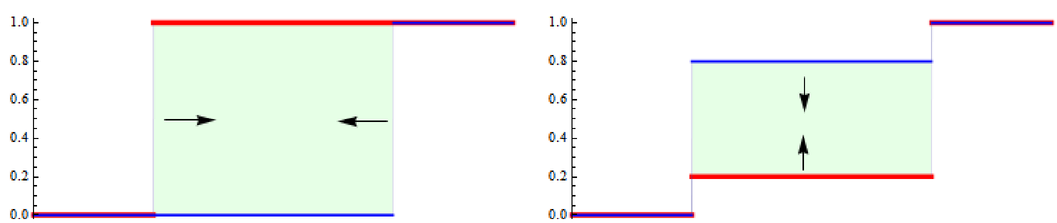


Figure 3: Deterministic Fairness Concerns (left) - Ex ante Fairness Concerns (right)



Legend: In red, the DM's marginal CDF; in blue counterpart's marginal CDF.

Figure 4: Tasks type 1 - Sharing Chances

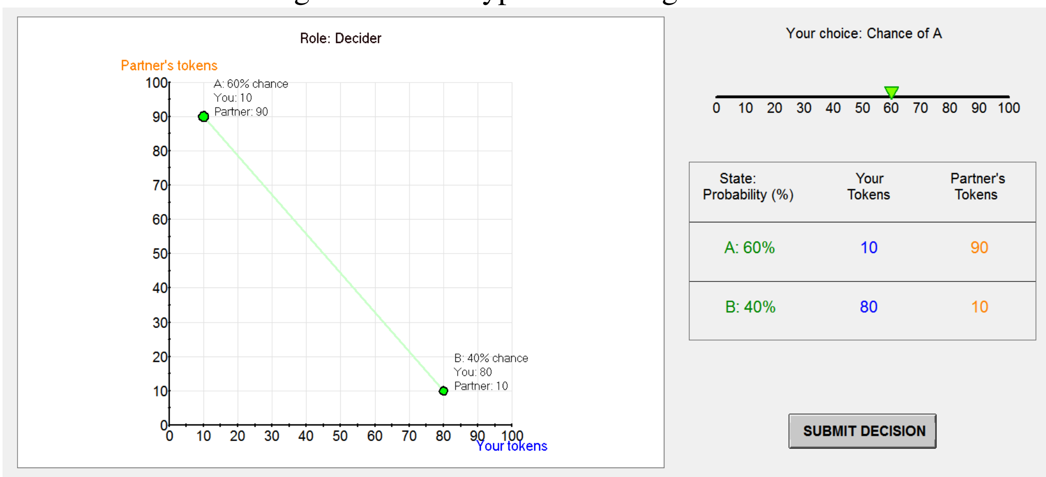


Figure 5: Tasks type 2 - Taking Fair-Risks

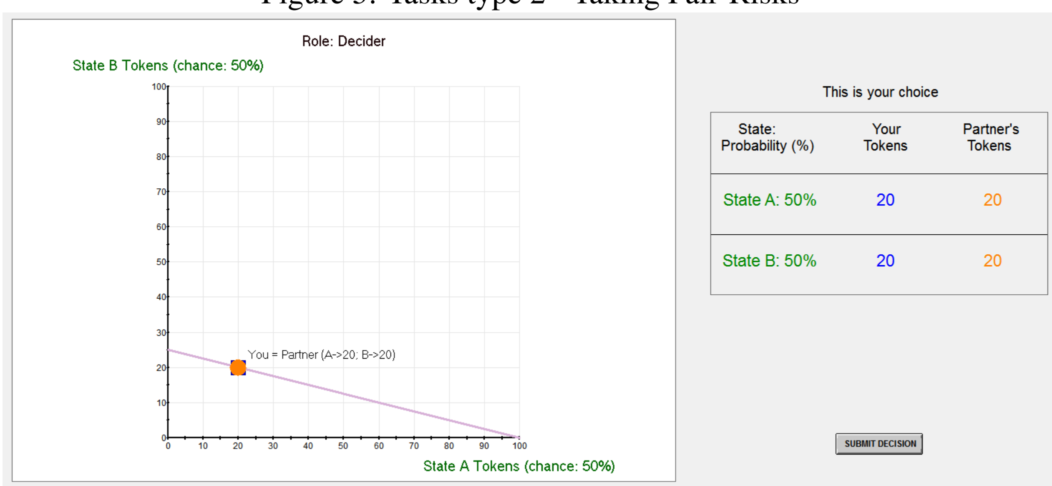


Figure 6: Tasks type 3 - Taking Unfair-Risks

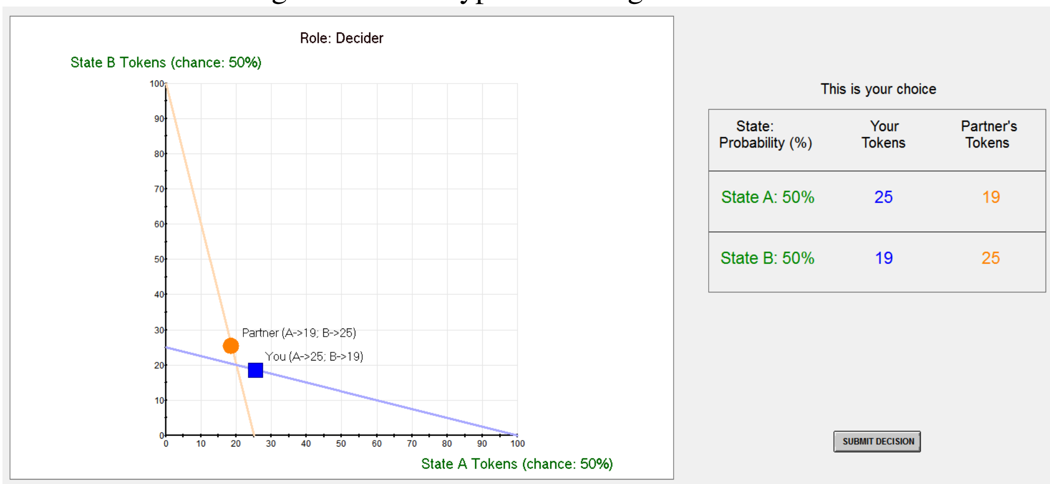


Figure 7: Tasks type 4 - Deterministic Giving

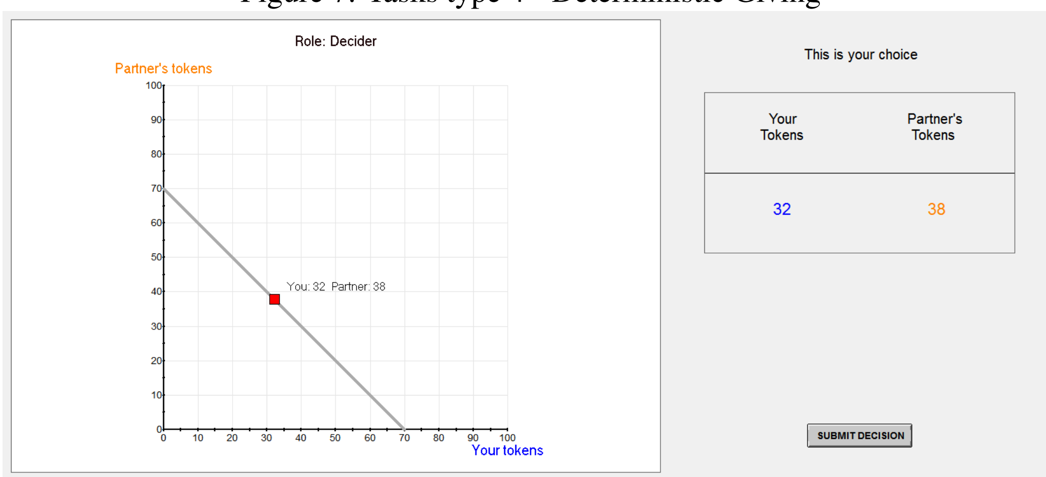
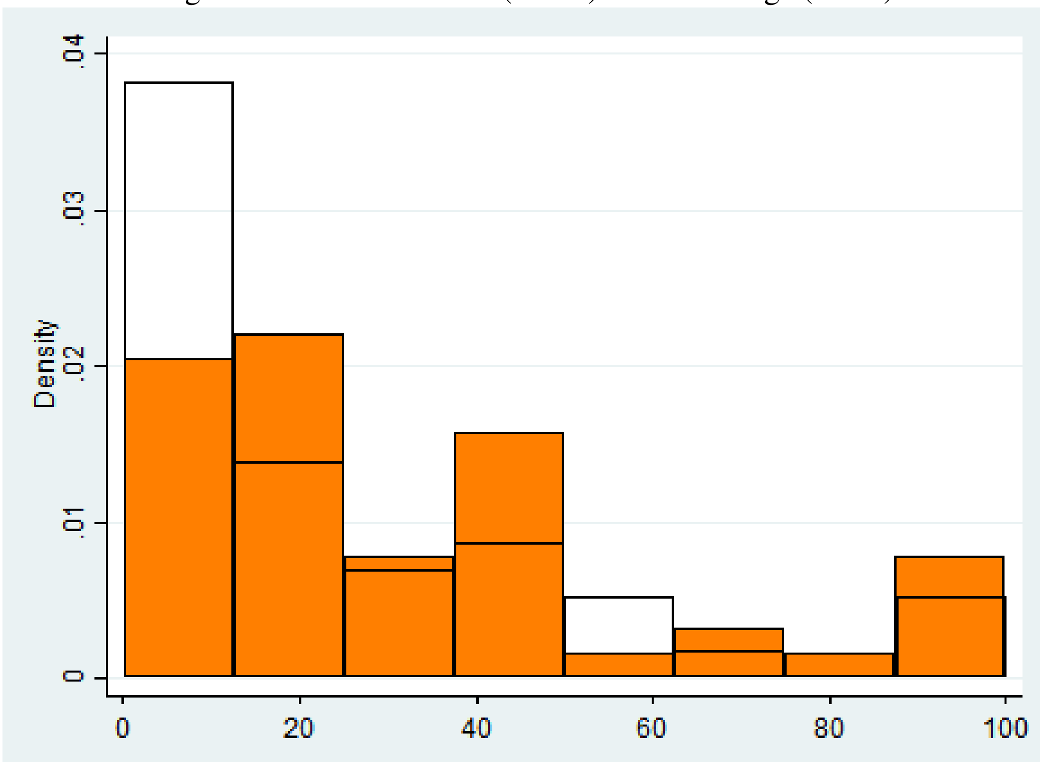


Figure 8: Tolerance to fair (unfair) risks in orange (white)



Tables

Table 1: Statistics - Task Type 1 - Sharing Chances

Decision Rounds Outcomes A, B	$-\frac{y_A - y_B}{x_B - x_A}$	$Pr[A]$	$s.e.$
A:(10,60); B:(80,30)	-0.43	11.09	2.61
A:(10,45); B:(80,10)	-0.50	19.65	4.09
A:(0,90); B:(90,0)	-1.00	17.55	3.76
A:(10,80); B:(80,10)	-1.00	19.62	4.12
A:(10,50); B:(50,10)	-1.00	21.75	4.07
A:(30,60); B:(60,30)	-1.00	22.85	3.71
A:(10,80); B:(45,10)	-2.00	30.29	4.57
A:(30,80); B:(60,10)	-2.33	28.02	4.39
A:(10,80); B:(45,45)	-1.00	10.33	3.09
A:(45,45); B:(80,10)	-1.00	36.78	5.43
A:(30,30); B:(60,60)	1.00	8.96	2.82

Table 2: Statistics - Tasks 2, 3 - Taking Fair and Unfair Risks

Decision Rounds	$R = \frac{Pr[B] I_B}{Pr[A] I_A}$	z_A Task 2	z_A Task 3	Safe Choice	Diff. Test
Pr[A]=50%; I_A=100; I_B=25	0.25	51.6	47.1	20.0	**
Pr[A]=50%; I_A=75; I_B=37.5	0.50	39.5	33.4	25.0	***
Pr[A]=50%; I_A=90; I_B=66	0.73	48.8	44.7	38.1	***
Pr[A]=50%; I_A=50; I_B=50	1.00	25.5	25.9	25.0	
Pr[A]=50%; I_A=76; I_B=76	1.00	38.9	38.6	38.0	
Pr[A]=50%; I_A=66; I_B=90	1.36	30.5	35.2	38.1	***
Pr[A]=50%; I_A=37.5; I_B=75	2.00	18.6	21.2	25.0	***
Pr[A]=50%; I_A=25; I_B=100	4.00	10.4	13.1	20.0	***
Pr[A]=70%; I_A=60; I_B=60	0.43	39.5	38.9	30.0	
Pr[A]=30%; I_A=60; I_B=60	2.33	18.5	21.3	30.0	
Pr[A]=90%; I_A=60; I_B=60	0.11	52.4	47.5	30.0	

Table 3: Statistics - Tasks 4 - Deterministic Giving

Budgets	Py/Px	$\bar{x}$ (DM)	s.e. x	$\bar{y}$ (Partner)	s.e. y	$\bar{x}/\bar{y}$
Max X=25; Max Y=100	0.25	17.12	1.06	31.32	4.26	1.83
Max X=37.5; Max Y=75	0.50	26.41	1.35	22.23	2.7	0.84
Max X=65; Max Y=100	0.65	46.96	2.32	27.72	3.58	0.59
Max X=66; Max Y=90	0.73	46.17	2.36	27.08	3.22	0.59
Max X=50; Max Y=50	1.00	33.65	1.61	16.43	1.61	0.49
Max X=76; Max Y=76	1.00	54.73	2.21	21.3	2.21	0.39
Max X=90; Max Y=90	1.00	65.32	2.89	24.72	2.9	0.38
Max X=100; Max Y=65	1.54	70.5	3.63	19.26	2.36	0.27
Max X=90; Max Y=66	1.36	67.39	2.89	16.62	2.13	0.25
Max X=75; Max Y=37.5	2.00	53.16	2.86	11.03	1.43	0.21
Max X=100; Max Y=25	4.00	72.3	4.15	7.03	1.04	0.10

Table 4: Ex Post Fairness - Regression

	(1) $log\left(\frac{x_A}{x_B}\right)$	(2) $log\left(\frac{x_A}{x_B}\right)$	(3) $\hat{\alpha} = \frac{z_{high} - Safe}{\bar{Z} - Safe}$
$R_t = \frac{Pr[B]\,I_B}{Pr[A]\,I_A}$ $(in\ logs)$	-1.3028***	-1.2653***	
	(0.1067)	(0.0959)	
$log(R_t)$*$Unfair$	0.4346***	0.3693***	
	(0.1241)	(0.1110)	
$Unfair$		0.1129	-14.7906***
		(.2381)	(3.1583)
Individual R.E.	YES	YES	YES
Session Effects	YES	YES	YES
Observations	1141	1141	660
Groups	55	55	55

Notes: Unfair = 1 if Task 3, Unfair = 0 if Task 2.

$*$p<0.1; $**$p<0.05; $***$p<0.01; robust s.e. in parentheses; (1) and (2) Random-effects GLS regression; (3) Tobit regression with individuals random effects, and with $\hat{\alpha} \in [0, 100]$; Constant not reported.

Table 5: Ex Ante Fairness - Regression

	(1)	(2)	(3)
	$Pr[A]$ (%)	$Pr[A]$ (%)	$Pr[A]$ (%)
$\frac{y_A - y_B}{x_B - x_A}$	15.6075***		
	(3.7500)		
$log\left(\frac{y_A - y_B}{x_B - x_A}\right)$		18.8980***	18.7233***
		(4.4162)	(4.1443)
DM is ahead			31.1976***
			(6.5500)
DM is behind			-32.1916***
			(7.8714)
Individual R.E.	YES	YES	YES
Session Effects	YES	YES	YES
Log likelihood	-1380.55	-1379.98	-1358.24
Observations	550	550	550
Groups	55	55	55

Notes: ∗p<0.1; ∗∗p<0.05; ∗∗∗p<0.01; (1) - (3) Tobit regressions with individual random effects, and with $Pr[A] \in [0, 100]$; Constant not reported.

Table 6: Testing GEIA Model Prediction

	(1)	(2)
	$\hat{\alpha} = \frac{z_{high} - Safe}{\bar{Z} - Safe}$	$\hat{\alpha} = \frac{z_{high} - Safe}{\bar{Z} - Safe}$
$\hat{\delta}_s$ [0,100]	0.0262	
	(0.0865)	
Pr[A] (Average)		0.0939
		(0.3541)
Deterministic Giving (Av.)		-0.2165
		(0.5167)
Individual R.E.	YES	YES
Session Effects	YES	YES
Log likelihood	-818.19	-1236.91
Observations	222	330
Groups	37	55

Notes: $*$p<0.1; $**$p<0.05; $***$p<0.01; (1) - (2) Tobit regressions with individual random effects, and with $\hat{\alpha} \in [0, 100]$; Constant not reported.

Appendix

Proofs to Propositions

Proposition 1

Proof. For simplicity, here I provide the proof for non-corner solutions and differentiable g. First, notice that in either choice problem (risk taking with *fair* risks and with *unfair* risks) DM and her counterpart face the exact same marginal risk. Therefore, $D = 0$ always and utility becomes $U = \mathbb{E}g(x,y)$. That is, this proposition is a result emerging purely emerging from ex post motives.

Consider now the problem of choosing the optimal risk taking with fair risks, α^{f*}. This problem can be expressed as:

$$\max_{\alpha\in[0,1]} g\left(\alpha\bar{Z}, \alpha\bar{Z}\right) + g\left((1-\alpha)\underline{Z}, (1-\alpha)\underline{Z}\right) \tag{19}$$

where I have used the fact that $p_A = 0.5$. The corresponding first order condition (FOC) is:

$$\frac{\underline{Z}}{\bar{Z}} = \frac{g_1\left(\alpha^f\bar{Z}, \alpha^f\bar{Z}\right) + g_2\left(\alpha^f\bar{Z}, \alpha^f\bar{Z}\right)}{g_1\left((1-\alpha^f)\underline{Z}, (1-\alpha^f)\underline{Z}\right) + g_2\left((1-\alpha^f)\underline{Z}, (1-\alpha^f)\underline{Z}\right)} \tag{20}$$

Similarly, for the problem of choosing the optimal risk taking with unfair risks, α^{uf*}, the corresponding problem can be expressed as:

$$\max_{\alpha\in[0,1]} g\left(\alpha\bar{Z}, (1-\alpha)\underline{Z}\right) + g\left((1-\alpha)\underline{Z}, \alpha\bar{Z}\right) \tag{21}$$

and its associated FOC is:

$$\frac{\underline{Z}}{\bar{Z}} = \frac{g_1\left(\alpha^{uf}\bar{Z}, \left(1-\alpha^{uf}\right)\underline{Z}\right) + g_2\left(\left(1-\alpha^{uf}\right)\underline{Z}, \alpha^{uf}\bar{Z}\right)}{g_1\left((1-\alpha^{uf})\underline{Z}, \alpha^{uf}\bar{Z}\right) + g_2\left(\alpha^{uf}\bar{Z}, (1-\alpha^{uf})\underline{Z}\right)} \tag{22}$$

To look for a contradiction, suppose $\alpha^{uf} \geq \alpha^f$. In such case, we have:

$$\frac{\underline{Z}}{\bar{Z}} \quad = \quad \frac{g_1\left(\alpha^{uf}\bar{Z}, \left(1-\alpha^{uf}\right)\underline{Z}\right) + g_2\left(\left(1-\alpha^{uf}\right)\underline{Z}, \alpha^{uf}\bar{Z}\right)}{g_1\left((1-\alpha^{uf})\underline{Z}, \alpha^{uf}\bar{Z}\right) + g_2\left(\alpha^{uf}\bar{Z}, (1-\alpha^{uf})\underline{Z}\right)} \tag{23}$$

$$
\begin{aligned}
&< \frac{g_1\left(\alpha^{uf}\bar{Z}, \alpha^{uf}\bar{Z}\right)+g_2\left(\alpha^{uf}\bar{Z}, \alpha^{uf}\bar{Z}\right)}{g_1\left((1-\alpha^{uf})\underline{Z}, (1-\alpha^{uf})\underline{Z}\right)+g_2\left((1-\alpha^{uf})\underline{Z}, (1-\alpha^{uf})\underline{Z}\right)} \\
&\leq \frac{g_1\left(\alpha^{f}\bar{Z}, \alpha^{f}\bar{Z}\right)+g_2\left(\alpha^{f}\bar{Z}, \alpha^{f}\bar{Z}\right)}{g_1\left((1-\alpha^{f})\underline{Z}, (1-\alpha^{f})\underline{Z}\right)+g_2\left((1-\alpha^{f})\underline{Z}, (1-\alpha^{f})\underline{Z}\right)}
\end{aligned}
$$

where the first inequality holds because g satisfies strict supermodularity (see Definition 1), and the second inequality holds because g was assumed to be concave along the 45 degree line (to capture aversion to fair risks). Expression (23) contradicts the FOC for α^{f*}(Equation 20) and therefore $\alpha^{f*} > \alpha^{uf*}$ □

Proposition 2

Proof. I prove 2.i by constructing outcomes A and B that satisfy the proposition for given preferences $\mathbb{E}g - \delta D$. Recall it is assumed g is increasing in x and y, $\mu(t) = t$ and $p > 1$. It can be seen that for some $k > 0$ we can always form outcomes $A = (x_l, y_h)$ and $B = (x_h, y_l)$ such that: (i) $g(A) = g(x_l, y_h) = g(x_h, y_l) = g(B)$, and (ii) $y_h - x_l = x_h - y_l = k$. Since $D = k$ when either outcome A or B occurs for sure, we also have that $B \sim A$. Therefore, to show that the optimal probability of A is non trivial – i.e. $p_A \in (0,1)$, we only need to work with the ex ante term D.

Define $L = \frac{1}{2}A \oplus \frac{1}{2}B$ and denote by F_x^L and F_y^L as the corresponding marginal risks associated with lottery L.

Claim: $D\left(F_x^L, F_y^L\right) < k$. To see this claim, notice that given the conditions imposed on A and B, we have either: $y_l \leq x_l \leq x_h \leq y_h$ or $x_l \leq y_l \leq y_h \leq x_h$. WLOG, let me assume the first one. Therefore, we have: $D\left(F_x^L, F_y^L\right) = \frac{1}{2}^p(x_l - y_l) + \frac{1}{2}^p(y_h - x_h) \leq 2^{1-p}k < k$. This implies $L \succ A \sim B$, as desired.[26]

Next, I prove 2.ii. For simplicity, , I assume the exponent p inside equation (4) equals 2. Also, without loss of generality let me focus on the case where $\frac{y_A - y_B}{x_B - x_A} > 0$; that is, where each outcome is relatively advantageous to one of the agents (DM and her counterpart) and no outcome is dominated. Otherwise, optimal p_A will be zero or one.

[26]Importantly, notice I constructed outcomes A and B that will trigger ex ante fairness behavior ($p_A \in (0,1)$) for any strictly positive δ, even if it is arbitrarily small.

First, recall again that, given the assumptions, the utility is given by $U = \mathbb{E}g(x,y) - \delta D(F_x, F_y)$. Because we are restricted to the two outcome (A and B) case, it can be shown that: (i) as in the standard EU theory, $\mathbb{E}g(x,y)$ is a linear form on p_A: $p_A g(x_A, y_A) + (1-p_A)g(x_B, y_B)$, and (ii) D is a quadratic form over p_A: $D = c_0 - c_1 p_A + c_2 p_A^2$, with $c_j > 0$. Also, coefficients c_j will depend on x_A, y_A, x_B, y_B. If we assume non-corner solution and, therefore, the solution is given by the first order condition, $\frac{\partial U}{\partial p_A} = 0$, then the optimal p_A can be expressed as:

$$\begin{aligned} p_A &= \frac{g(x_A, y_A) - g(x_B, y_B) - \delta c_1}{\delta 2 c_2} \\ &= \frac{1}{\delta} \frac{g(x_A, y_A) - g(x_B, y_B)}{2c_2} - \frac{c_1}{2c_2} \end{aligned} \tag{24}$$

From this solution, we can see that for small enough δ, p_A will depend positively on x_A, y_A and negatively on x_B, y_B, regardless how these outcomes affect c_1 and c_2. The proof is complete. $\square$

Proposition 3

Proof. For simplicity, I assume the case of a non-corner solution. In the GEIA model, $U(L) = \delta_s u(\mathbb{E}[x,y]) + (1-\delta_s)\mathbb{E}[u(x,y)]$. Also, because the proposition is restricted to the case of fair lotteries, we can define $v(z) = u(z,z)$ which we have already assumed to be concave. Further, using the definition of fair lotteries $L^{fair}(\alpha)$ in the corresponding choice problem, we have that:

$$U(L^{fair}) = \delta_s v\left(\alpha \frac{\bar{Z} - \underline{Z}}{2} + \frac{\underline{Z}}{2}\right) + \left(\frac{1-\delta_s}{2}\right)\left(v\left(\alpha \bar{Z}\right) + v\left((1-\alpha)\underline{Z}\right)\right) \tag{25}$$

Using the first and second order conditions as well as the implicit function theorem, we have that:

$\frac{d\alpha^{fair*}}{d\delta_s} = -\left(\frac{\partial U_\alpha}{\partial \delta_s} / \frac{\partial U_\alpha}{\partial \alpha}\right)_{\alpha = \alpha^{fair*}}$, where $U_\alpha = \frac{\partial U(L^{fair}(\alpha))}{\partial \alpha}$, and $\alpha = \alpha^{fair*}$solves $U_\alpha = 0$. Furthermore,$\left(\frac{\partial U_\alpha}{\partial \alpha}\right)_{\alpha = \alpha^{fair*}}$ is negative as it is simply the second order condition (SOC) of a maximization problem. Next, I show $\left(\frac{\partial U_\alpha}{\partial \delta_s}\right)_{\alpha = \alpha^{fair*}} > 0$. To see this, notice that:

$$U_\alpha = \frac{\partial U(L^{fair}(\alpha))}{\partial \alpha} = \delta_s v'\left(\alpha\frac{\bar{Z}-\underline{Z}}{2}+\frac{\underline{Z}}{2}\right)+\left(\frac{1-\delta_s}{2}\right)\left(\bar{Z}v'\left(\alpha\bar{Z}\right)-\underline{Z}v'\left((1-\alpha)\underline{Z}\right)\right) \quad (26)$$

and therefore:

$$\frac{\partial U_\alpha}{\partial \delta_s} = v'\left(\alpha\frac{\bar{Z}-\underline{Z}}{2}+\frac{\underline{Z}}{2}\right)-\frac{1}{2}\left(\bar{Z}v'\left(\alpha\bar{Z}\right)-\underline{Z}v'\left((1-\alpha)\underline{Z}\right)\right) \quad (27)$$

If I show $\bar{Z}v'\left(\alpha\bar{Z}\right)-\underline{Z}v\left((1-\alpha)\underline{Z}\right)\leq 0$ at optimal α, then the proof is complete. By contradiction, if instead we have $\bar{Z}v'\left(\alpha\bar{Z}\right)-\underline{Z}v\left((1-\alpha)\underline{Z}\right)>0$, then the corresponding α is not a solution as $U_\alpha>0$ regardless α. Summing up, $\bar{Z}v'\left(\alpha\bar{Z}\right)-\underline{Z}v\left((1-\alpha)\underline{Z}\right)\leq 0$, therefore $\left(\frac{\partial U_\alpha}{\partial \delta_s}\right)_{\alpha=\alpha^{fair*}}>0$, and consequently $\frac{d\alpha^{fair*}}{d\delta_s}>0$. □

Proposition 4

Proof. This proof is immediate from the continuity and differentiability of u, and from the fact that purely ex ante decision makers will choose to maximize the expected value regardless whether the lotteries are fair or unfair. That is, if $\delta_s=1$, then $\alpha^{fair*}=\alpha^{unfair*}=1$. □

Proposition 5

Proof. I assume that u is increasing in x everywhere, and u is increasing in y it $x>y$. I had already assumed that u is concave, I strengthen this by assuming u is also strictly concave at least somewhere (e.g. if u is the F&S utility, u is strictly concave along the 45 degree line). Under these rather general conditions, it is easy to see that there exist a and b such that this deterministic-dictator choice problem:

$$\max_{s\in[0,1]} u(s0+(1-s)b\,,\,sa+(1-s)0) \quad (28)$$

has an non-corner solution $s^*\in(0,1)$.

Consider any arbitrary a and b such that the corresponding $s^*$is in fact in the interval $(0,1)$. We want to study the choice problem:

$$\max_{p\in[0,1]} \quad \delta_s u\left((1-p)\,b\,,\,p\,a)\right)+ \\ (1-\delta_s)\left(pu(0,a)+(1-p)\,u(b,0)\right) \tag{29}$$

whose solution is denoted by p^*. This is the probabilistic giving problem where $A=(0,a)$ and $B=(b,0)$. Let me assume, WLOG, that $B \succ A$ – i.e. $u(B)>u(A)$. The following four claims suffice for Proposition 5.

Claim 1: if $\delta_s=0$, then $p^*=0$.
This is an immediate result from the fact that in this case we are in the standard expected utility model.

Claim 2: if $\delta_s=1$, then $p^*=s^*$.
This is a result emerging from the fact that for purely ex ante driven decision makers the *probabilistic giving* problem (expression 29) is equivalent to the standard *deterministic* giving problem (expression 28). Therefore their solutions are equivalent as well.

Claim 3: if $\delta_s<1$, then $p^*<s^*$
Consider the following function:

$$h(p)=u\left((1-p)\,b\,,\,p\,a)\right) \tag{30}$$

which is concave in p necessarily. It is easy to see that the utility we are maximizing can be expressed as:

$$\delta h(p)+(1-\delta)\left(\,p\,h(1)+(1-p)\,h(0)\,\right) \tag{31}$$

and the corresponding FOC is:

$$U_p=\delta h'(p^*)+(1-\delta)\left(\,h(1)-h(0)\,\right)=0 \tag{32}$$

Suppose that $p^* \geq s^*$. Notice that $h(1) - h(0) < 0$ – as I assumed B is preferred over A – and $h'(s^*) = 0$. Then $h'(p^*) \leq 0$ and so $U_p < 0$ regardless p: a contradiction. Therefore $p^* < s^*$.

Claim 4: $\frac{dp^*}{d\delta_s} > 0$

Notice that (i) Claim 3 implies $h'(p^*) > 0$, (ii) $\frac{\partial U_p}{\partial \delta} > 0$ at $p = p^*$, and (iii) $\frac{\partial U_p}{\partial p} > 0$ at $p = p^*$. Then, by the implicit function theorem, $\frac{dp^*}{d\delta_s} > 0$. □

Robustness

For these robustness exercise of Result 3, I define two Risk Tolerance Indices (RTI1 and RTI2). Both are defined as the average at individual level all $\hat{\alpha}$'s from choices that induced tension between risks and returns (i.e. $I_A \neq I_B$). In RTI1 I use the nine decision rounds of such kind (see Table 2). In RTI2, I used only $\hat{\alpha}$'s from the choices that implied the highest tension between risks and returns ($\bar{Z}/\underline{Z}$ = 4). This occurred in two choice problems of each task 2 and 3.

In the following regressions, the depvar is the RTI1 and RTI2, respectively. The main regressors are measures of the strength of ex ante fairness behavior. As before, I control for choices from tasks 4 (deterministic giving). These regression exercises are reported in the regression Tables 7 and 8. In these regressions, "Ex ante fairness index 1" equates to chosen p* when A=(0,90); B=(90,0); "Ex ante fairness index 2" equates to average chosen p* among choice problems where relative expected benefit of A over B equals 1; "Ex ante fairness index 3" equates to average chosen p* among choice problems where relative expected benefit of A over B is below 1; and "Ex ante fairness index 4" equates to average chosen p* among all choice problems where neither A or B dominate the other outcome in first order stochastic sense. "Deterministic Giving 1 - 4" in those regressions, correspond to the analogous choices except for tasks of type 4.

In each of these two regression, the first five rows contain ex ante fairness variables (our variable of interest). It can be seen that there is no statistical indication of a relation between stronger ex ante fairness behavior (giving more in chances) and higher tolerance to risks. Again, Hypothesis 3 is rejected.

Table 7: Testing GEIA Model Prediction - Robustness 1 RTI_1

	(1)	(2)	(3)	(4)	(5)	(6)
Delta Proxy	0.089					
	(0.141)					
Ex-ante fairness index 1		-0.153				
		(0.162)				
Ex-ante fairness index 2			-0.068			-0.279
			(0.300)			(0.298)
Ex-ante fairness index 3				-0.012		0.275
				(0.288)		(0.297)
Ex-ante fairness index 4					-0.053	
					(0.342)	
Det. Giving 1		-0.036				
		(0.217)				
Det. Giving 2			-0.205			-1.366***
			(0.424)			(0.408)
Det. Giving 3				0.326		0.923*
				(0.400)		(0.502)
Det. Giving 4					-0.020	
					(0.486)	
Constant	29.706***	33.826***	36.005***	21.959***	31.885***	31.668***
	(4.589)	(6.086)	(6.981)	(7.140)	(7.378)	(6.664)
Pseudo R2	7.0e-04	1.9e-03	1.8e-03	4.9e-03	1.7e-04	.033
N	55	55	55	55	55	55

Notes: See text for detailed construction of depvar. All Tobit regressions used LL=0 and UL=100. Standard errors in parentheses. Significance: * 0.10; ** 0.05; *** 0.01.

Table 8: Testing GEIA Model Prediction - Robustness 2 RTI_2

	(1)	(2)	(3)	(4)	(5)	(6)
Delta Proxy	0.073					
	(0.182)					
Ex-ante fairness index 1		-0.363*				
		(0.194)				
Ex-ante fairness index 2			-0.117			-0.294
			(0.366)			(0.372)
Ex-ante fairness index 3				-0.226		0.200
				(0.356)		(0.347)
Ex-ante fairness index 4					-0.258	
					(0.438)	
Ex-post fairness index 1		-0.524*				
		(0.309)				
Ex-post fairness index 2			-0.921			-2.496***
			(0.563)			(0.616)
Ex-post fairness index 3				0.285		1.342**
				(0.455)		(0.602)
Ex-post fairness index 4					-0.440	
					(0.607)	
Constant	44.979***	64.586***	67.127***	44.394***	60.100***	61.547***
	(6.933)	(10.749)	(12.089)	(10.969)	(12.219)	(10.931)
Pseudo R2	2.5e-04	.015	.013	1.4e-03	5.9e-03	.042
N	55	55	55	55	55	55

Notes: See text for detailed construction of depvar and regressors. All Tobit regressions used LL=0 and UL=100. Standard errors in parentheses. Significance: * 0.10; ** 0.05; *** 0.01.

Experimental Instructions

This is an experiment in decision-making. Several research foundations have provided funds for this study. Your final earnings today will depend partly on your decisions, partly on the decisions of others and partly on chance. Precise rules will be explained below. Please pay careful attention to the instructions. At the end of the experiment, you will be paid in cash. All payments will be made in private. Also, you will receive $7 as a participation fee, simply for showing up on time.

During the experiment we will use *Experimental Tokens* instead of dollars. At the end of the experiment, your earnings in tokens will be translated into dollars. You will receive 1 dollar for every 5 tokens you have earned in the session.

It is important that you do not talk or in any way try to communicate with other people during the session. If you have a question, raise your hand and an experimenter will attend to your station to answer your question privately. The experiment should be finished in approximately one hour.

Pairs

At the beginning of the experiment, you will be randomly and anonymously matched with one other participant to form a *pair*. Within each pair there will be one person with the role of "*Decider*" and another person with the role of "*Partner*." These roles will be assigned randomly, and will remain for the entire session. No participant will learn in any way the identity of his/her counterpart at any moment of the session.

In each pair, <u>only choices made by the *Decider* will determine final payoffs</u>. Although the *Partner* will face the same kinds of tasks, his/her choices will not determine anyone's payoffs.

Tasks, Decision Rounds and Earnings

This experiment will consist of a series of *decision rounds* of five different types of tasks. Each kind of task will be detailed below. At the end of all decisions, the computer will randomly select one choice made by the *Decider* and generate payoffs for both *Decider* and *Partner* based on that selected choice. The selected choice as well as the final payoffs it generates will be disclosed to both participants.

Please, raise your hand if you have any questions. Do not ask any questions out loud. Remember not to discuss your role, choices or results with any other participant at any time during the experiment. When you are done, please wait quietly until the rest of participants finish their tasks. Thank you!

Task Type 1

Decider Task:

In this task, you are given two fixed, mutually exclusive outcomes. You are then asked to decide the probabilities of these two outcomes.

Figure 1: Task 1

[in text]

In the left-side graph, *your tokens* are represented on the horizontal axis and *Partner's tokens* on the vertical axis. Each of the two possible outcomes is represented by a cross or a bubble in this graph. You must decide what the probability of each outcome is, in percentage (%) terms. Figure 1 shows an example of this task where the two fixed outcomes are A = (You: 10, Partner: 90) and B = (You: 80, Partner: 10).

On the right side of the screen you have a slider tool where you can chose the *chance of Outcome A*, from 0% to 100%. Drag the *green triangle* onto your chosen percentage. If you choose 100, outcome *A* will occur for sure. If you choose 0, outcome *B* will occur for sure. In the graph, the size of each outcome bubble will increase with the chances it is given. You can try as many combinations as you want before you decide. The same information of the graph is displayed in the small table below the slider bar. Throughout this session, your tokens will be represented in blue and *Partner*'s tokens in orange. Once you make your choice, press the *submit decision* button and continue to the next round. Please think your decisions carefully.

Partner Task:

You will face the same kind of task as your counterpart, the *Decider*, except your choices will be hypothetical. They will not affect payoffs for any participant. Please think your decisions carefully.

Interface for Tasks 2 and 3

In each decision round, there will be two probable states: State A and State B. Think of these states as the weather: it could be either *sunny* or *cloudy*. However, when you make your decision, it is uncertain which state will occur.

Your decision will be represented by a point on a graph like the one in Figure E. In this graph, the horizontal axis indicates *Tokens paid if State A occurs*, and the vertical axis indicates *Tokens paid if State B occurs*. The chance that each state will occur is displayed in parentheses on the corresponding axis label. In Figure E, for instance, the probability of State A is 50%, and the probability of State B is 50%, as well. However, beware that these probabilities might be different in another decision rounds.

The position of a point on this graph represents a lottery. For example, in Figure E, the point on location (40, 27) indicates that if State A is realized, the lottery pays 40 tokens; and if State B is realized, the lottery pays 27 tokens. Decider's lottery will be depicted by a *blue square* and *Partner*'s lottery by an *orange circle.*

Figure E: Decision Interface Tasks 2, 3

[in text]

Task Type 2

Decider's Task:

For Task 2, both *Decider* and *Partner* share the same fortune: in each state, the amount of tokens both receive is the same. See for example, Figure 2. Here states A and B each occur with a 50% chance. Also, since both participants face the exact same fate, *Decider*'s blue square and *Partner*'s orange circle are always located on the same spot. In Figure 2, they both are on location (40, 27). This means, if State A happens, you and your *Partner* will both get 40 tokens and if State B occurs instead, you both get 27 tokens.

At the beginning of each decision screen, the square and the circle will appear by the (0, 0) combination. To make a choice drag the square or the circle to your chosen location. The other shape will follow. Only combinations on the purple line are feasible choices. The computer will not let you choose a combination outside the purple line. The same information displayed in the graph is shown in the table next to it. Each row represents one possible state and the tokens paid if such state occurs. You can try as many combinations as you want before you decide. Once you make your choice, press the *submit decision* button and continue to the next round.

Please beware that the probabilities of each State might vary across different decision rounds. Please think your decisions carefully.

Figure 2: Task 2

[in text]

Partner's Task:

You will face the same kind of task as your counterpart, the *Decider*, except your choices will be hypothetical. They will not affect payoffs for any participant. Please think your decisions carefully.

Task Type 3

Decider's Task:

For Task 3, *Decider* and *Partner* have *opposite fortunes*. What *Decider* would get in State A equals what *Partner* would receive in State B. Similarly, what *Decider* would get in State B is what *Partner* would get in State A.

See example in Figure 3 where states A and B both occur with 50% chance. Here, since both counterparts face reverse fate, *Decider*'s blue square and *Partner*'s orange circle are always in mirror positions on the graph. In Figure 4, for example, *Decider*'s square is at (A⟶20, B⟶54) and *Partner*'s circle at (A⟶54, B⟶20). This means, if State A happens, *Decider* receives 20 and *Partner* gets 54; and if State B happens *Decider* gets 54 and *Partner* gets 20. Also, beware that the probabilities of each State might vary across different decision rounds.

At the beginning of each decision screen, the square and the circle will appear by the (0, 0) combination. To make a choice drag either the square or the circle to your chosen location. The other shape will locate accordingly. For the *Decider*, feasible combinations are along the light blue line and for *Partner* along the light orange line. The computer will not let you choose a combination outside these lines. The same information displayed in the graph is shown in the table next to it. Each row represents one possible state and the tokens paid if such state occurs. You can try as many combinations as you want before you decide. Once you make your choice, press the *submit decision* button and continue to the next round. Please think your decisions carefully.

Figure 3: Task 3

[in text]

Partner's Task:

You will face the same kind of task as your counterpart, the *Decider*, except your choices will be hypothetical. They will not affect payoffs for any participant. Please think your decisions carefully.

Task Type 4

Decider Task:

In this task, you will be given a set of possible token combinations for you and your *Partner*. You are asked to choose one combination and submit your decision.

Figure 4: Task 4

[in text]

Figure 4 shows an example of this kind of task. You will see a graph on a white background representing token allocations. In all rounds of this task, *your tokens* will be indicated on the horizontal axis and your *Partner's tokens* on the vertical axis. The same information is also displayed in the table on the right of the screen. Throughout this session, your tokens will be represented in blue and *Partner*'s tokens in orange.

For example, the point (32, 38) depicted in Figure 4 by a red square indicates that you will receive 32 tokens and your counterpart will receive 38 tokens. This is also indicated in the label "You: 32, *Partner*: 38" and in the table (see projector screen).

At the beginning of each task, the red square will appear by the (0, 0) combination. To make a choice, click, hold and drag the red square with the mouse to any position within the *gray line*. Only combinations along this *gray line* are feasible, valid choices. The computer will not let you chose any point but those. You can try as many combinations as you want before you make your decision. Once you have the red square at the intended position, press the *submit decision* button and continue to the next round. Please think your decisions carefully.

Partner Task:

You will face the same kind of task as your counterpart, the *Decider*, except your choices will be hypothetical. They will not affect payoffs for any participant. Please think your decisions carefully.