An Experimental Study on Individual Choice, Social Welfare, and Social Preferences

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March, 2008

Abstract We experimentally study subjects' compliance with dominance relationships of income distributions in a ranking task. The experiment consisted of four different treatments: lottery, individual choice, social preferences, and social planner. Our results suggest that people's risk attitudes do not adequately reflect their inequality attitudes. Uninvolved social planners exhibit randomization preferences, while self-interested social planners are generally more inequality averse and try to avoid extreme outcomes.

JEL classification: D31, C91, D63.
Keywords: inequality, risk, social preferences, procedural fairness

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1 Introduction

The main objective of the present paper is to study experimentally how subjects solve equity-efficiency trade-offs in a ranking task of income distributions. In particular, we are interested in knowing whether and how the “weights” that are assigned to the equity and efficiency components in subjects’ objective functions differ between different treatments. Four treatments are being considered: a lottery treatment, an individual-choice treatment, a social-preferences treatment and a social-planner treatment. Evidence is reported in terms of a between-subjects analysis of the subjects’ compliance with dominance relationships that cover only the efficiency aspects (Pareto dominance), the equity aspects (transfer dominance and Lorenz dominance), or both aspects of income distributions (generalized Lorenz dominance).

Recent experimental evidence suggests that in evaluating income (or payoff) distributions people are not only motivated by self-interest but also care about what other people get (see, for example, Andreoni and Miller, 2002; for a literature survey see Fehr and Schmidt, 2003). Theoretical models explaining this observation by so-called *social preferences* have been proposed, for instance, by Bolton and Ockenfels (2000), Charness and Rabin (2002), Fehr and Schmidt (1999), and Levine (1998). These models have in common that the utility of a person is assumed to depend not only on the person’s own monetary payoff but also on a specific social welfare function (SWF) of the payoff distribution. For example, Charness and Rabin (2002) consider a convex combination between a subject’s own monetary payoff and a SWF made up of a Rawlsian and a utilitarian SWF.

Ultimately, the theory of social preferences is some kind of hybrid model of the social-planner approach and the individual-choice approach. In the social-planner approach, the social welfare function lacks any personal involvement as the social-planner does not become a member of the society (see Dalton, 1920; Boulding, 1962; Atkinson, 1970; Blackorby and Donaldson, 1978; Cowell and Kuga, 1981; Cowell, 1985, 1995; Chakravarty, 1990; and Lambert, 1993). In the individual-choice approach, pioneered by Friedman (1953), income distributions are considered as gambles. Self-interested people evaluate income distributions from under a veil of ignorance, that is, they become a member of the respective society after having made their choices, but they do not know their own future income positions in advance (see Vickrey, 1945, 1960, 1961; Fleming, 1952; Goodman and Markowitz, 1952; Friedman, 1953; Harsanyi, 1953, 1955; Rawls, 1958, 1971; Strotz, 1958, 1961; Dworkin, 1981; Kolm, 1985, 1998; Dahlby, 1987; Epstein and Segal, 1992; Fleurbaey, 1998; and Beckman et al., 2002). To put it simply, the individual-choice approach assumes that a self-interested subject maximizes the (expected) utility of her own monetary payoff, while the social-planner approach assumes that the planner maximizes the social welfare of an external society. If there is no trade-off between equity and efficiency, that is, everyone can obtain more without simultaneously increasing perceived inequality, the distinction between these three approaches is of no particular relevance. However, if distributional preferences involve such a trade-off, one might surmise that it matters whether the decision maker maximizes her own payoff, the welfare of some external society, or a combination of both.

There are many possible methods to analyze subjects' exposure to the equity-efficiency trade-off. One could, for example, try to estimate subjects' parameters of relative risk aversion and inequality aversion, respectively, as Carlsson et al. (2005) did in a recent experimental study. Traub et al. (2005) conducted an experimental "beauty contest" of several SWFs. In this paper, we investigate subjects' compliance with distributional axioms from a social-welfare point of view (for related literature see, for example, Amiel and Cowell, 1992, 1994a, 1994b, 1998, 1999a, 1999b, 2000; Ballano and Ruiz–Castillo, 1993; Harrison and Seidl, 1994a, 1994b; Bernasconi, 2002). These studies have shown that the most basic axioms of inequality measurement, such as anonymity, scale invariance, translation invariance, Pigou's transfer principle, decomposability (introduced by Shorrocks, 1980), and the population principle, enjoy but modest support, which ranges between 30% and 60% of responses. Amiel and Cowell (1999a, p. 43), for instance, found that 76% of their subjects rejected the Lorenz axiom system. Camacho-Cuena et al. (2007) observed widespread empirical rejection of the leaky-bucket theory (Okun 1975), which is tantamount to violating the transfer principle (Lasso de la Vega and Seidl 2007).

In the experiment presented in this paper, subjects had to rank 12 income distributions involving dominance relations in terms of absolute Pareto dominance (McClelland and Rohrbaugh, 1978), Pareto rank dominance (Saposnik, 1981, 1983), transfer dominance, Lorenz dominance, and generalized Lorenz dominance (Shorrocks, 1983). While Pareto dominance captures the efficiency aspect of income distributions, transfer dominance and Lorenz dominance focus on the equity aspect. Generalized Lorenz dominance takes both efficiency and equity aspects into account.

The different scenarios were re-enacted by assigning subjects to four treatments. All subjects had to evaluate the same set of income distributions. However, the decision problem involved different framings and incentive schemes. In treatment one (lottery-treatment), subjects were presented a "neutral" lottery framing, that is, any connotation with income distributions was avoided. Subjects solely determined their own payoffs. Treatment two (individual-choice treatment) was similar to the lottery treatment. However, here (and in the remaining two treatments) the decision problem was framed as one of ranking income distributions according to their social desirability. Please note that, in the blueprint state of our experiment, we were virtually certain that the individual-choice treatment would generate a Friedman-Harsanyi-type scenario. Our preliminary results, however, induced us to conduct a fourth treatment involving a pure lottery framing as well, where no reference to income distributions was given at all.[1] Subjects in the third treatment (social-preferences treatment) had to determine both their own payoffs and the payoffs of their group members, and subjects in the fourth treatment (social-planner treatment) decided only on the other subjects' payoffs without being paid themselves. Hence, our experimental design allows us to investigate subjects' social preferences for the entire income distribution and to separate between the subjects' preferences for their individual payoffs and the payoff distribution of the others. Note that we applied an incentive mechanism with real payments to be explained in Section 3.

Beforehand, similar settings were used by Bernasconi (2002), and Bosmans and Schokkaert (2004).[2] Dealing with earnings distributions from job offers, Bosmans and Schokkaert (2004) considered three different scenarios: "impartial observer" (ISO), "veil of ignorance" (VOI), and "pure individual risk" (PIR). Using a different cover story and presentation, Bernasconi (2002) applied "external observer", "Harsanyi's income risk", and "pure risk" treatments. These scenarios coincide to some extent with our social-planner treatment, social-preferences treatment and lottery treatment. Though both

[1]The lottery treatment was suggested by an Associate Editor and a Referee.

[2]Both papers used the questionnaire approach, that is, income distributions were hypothetical instead of representing real monetary payoffs as in our paper.

papers also explore (and report) between-treatment differences, their main focus rests on the consistency of people's preferences with an additively separable welfare function or, more precisely, the axioms of expected utility theory (EUT). Bosmans and Schokkaert (2004, p. 99) reported that "ISO and PIR versions are furthest removed from each other while the results for the VOI version lie in between." Fanning-out, i.e. people choose risk averse if the options are relatively certain and risk loving if the options are relatively uncertain (see Machina, 1982), was the dominating preference pattern in the ISO treatment (and is inconsistent with EUT). The number of cases compatible with the opposite preference pattern, namely fanning-in, significantly increased while moving from ISO over VOI to PIR.

The paper is organized as follows: Section 2 sets up the theoretical framework of our paper. In Section 3, we give a detailed description of the experiment, state our research hypotheses, and discuss their theoretical background. Our results are presented in Section 4. Section 5 summarizes the main results and concludes the paper.

2 Dominance Relations of Income Distributions

We start considering Pareto dominance. Generically, Pareto dominance holds if no income recipient loses and at least one wins. There are several ways, however, to apply the Pareto principle to income distributions. Let $x = (x_1, x_2, \ldots, x_n)$ and $y = (y_1, y_2, \ldots, y_n)$ denote two non-decreasingly ordered income distributions with equal population size. Then, an immediate interpretation of Pareto dominance is given by

Definition 1 (Pareto rank dominance (PR)) *x Pareto rank dominates*

y if $x_i \geq y_i \; \forall \; i = 1, 2, \ldots, n$ and the inequality sign is strict for at least one income recipient.

Pareto rank dominance is the view taken, for example, by Saposnik (1981, 1983). It is equivalent to first–order stochastic dominance (if lotteries instead of income distributions are considered).

However, Pareto rank dominance harbors a difficulty if subjects' ranks within income distributions may be subject to change. Then an income recipient has to cope with a possibly different income rank when switching from y to x. Consequently, worsening the position of any income recipient can only be avoided if the interpretation of Pareto dominance of x over y is adjusted to:

Definition 2 (Absolute Pareto dominance (AP)) *x absolutely Pareto dominates y if $x \geq \Pi y$ for all permutation matrices Π, which implies that $\min_i\{x_i\} \geq \max_i\{y_i\}$.*

Absolute Pareto dominance is the view taken by McClelland and Rohrbaugh (1978). It is too strong when individuals can rely on keeping their income rank in different income distributions (which they could not in our experiment).

The principle of transfers requires that an income distribution which results from a transfer from a richer to a poorer income recipient, where the transfer preserves the ranks of the two individuals concerned, should be given preference to the original distribution. It is a mean–and–rank–preserving contraction.

Definition 3 (Transfer dominance (T)) *x dominates y according to the principle of transfers if x was obtained from y by a mean–and–rank–preserving* *contraction, that is,* $x_i = y_i \ \forall \ i \neq j,k, \ j < k,$ *and* $0 < \delta < \min_{i,j} |y_i - y_j|$ *such that* $x_j = y_j + \delta$, $x_k = y_k - \delta$.

Let X denote the total income of x. Then the Lorenz curve of x is defined by $L_x\left(j/n\right) = \sum_{i=1}^{j} x_i/X$ for $j = 1, 2, \ldots, n$, and we can state:

Definition 4 (Lorenz dominance (L)) *Income distribution* x *Lorenz dominates income distribution* y *if* $L_x(j/n) \geq L_y(j/n) \ \forall \ j = 1, 2, \ldots, n$.

Generalized Lorenz–dominance was suggested by Shorrocks (1983). Its idea is quite simple: the Lorenz curve of an income distribution is scaled up by mean income μ.

Definition 5 (Generalized Lorenz dominance (GL)) *Income distribution* x *generalized Lorenz dominates income distribution* y *if* $\mu_x L_x(j/n) \geq \mu_y L_y(j/n) \ \forall \ j = 1, 2, \ldots, n$ *and the inequality is strict for at least one* j.

As to the dominance relations to be tested, note that

1. absolute Pareto dominance implies Pareto rank dominance;

2. Pareto rank dominance implies generalized Lorenz dominance, but it does not imply Lorenz–dominance[3];

3. transfer dominance implies both Lorenz and generalized Lorenz dominance, but is not implied by them;

4. neither does Lorenz dominance imply generalized Lorenz dominance, nor does generalized Lorenz dominance imply Lorenz dominance;

5. if x Lorenz dominates y and $\mu_x \geq \mu_y$, Lorenz dominance implies generalized Lorenz dominance.

[3]Suppose $x_i = y_i = \alpha > 0 \ \forall \ i = 1, \ldots, n-1$, and $\alpha = y_n < x_n$. Then x Pareto rank dominates y, while y Lorenz dominates x.

3 Experimental Design

3.1 Stimulus Material and Proceeding

Our subjects were 252 students of the University of Hannover, mostly students of economics and business administration, and industrial engineering. They were arranged in four groups consisting of 65, 60, 61, and 66 subjects. Each group received a separate treatment: lottery treatment (65 subjects), individual-choice treatment (60 subjects), social-preferences treatment (61 subjects), and social-planner treatment (66 subjects). No subject was allowed to participate in more than one treatment. Individual-choice treatment, social-preferences treatment, and social-planner treatment were conducted in three parallel classes of the same introductory economics course. In the original design, the lottery treatment was not provided. Hence, it was conducted one year later in the same introductory economics course. Students repeating the course had to leave the lecture hall before the experiment took place.

The stimulus material was the same for all four groups. The treatments differed only with respect to the payoff mechanism for the subjects and the framing. At the beginning of the experiment, each subject received an envelope with twelve slips of cardboard along with written instructions, which were also read to the subjects (for the wording of the instructions, see the Appendix). In particular, our subjects were carefully informed about the payoff mechanism. In the three original treatments, an income distribution was displayed on each slip of cardboard which consisted of exactly five entries of reasonable annual incomes in Euros. Each of the five entries represented the incomes of a quintile of the population of an imaginary country, that is, 20% of the population had the first income per capita, 20% had the second income per capita, etc. The slips of cardboard were coded by symbols rather than numbers to avoid ordering effects; numbers for the income distributions are only introduced for reference purposes in this paper. Table 1 displays a synopsis of the stimulus material.

In the lottery framing, the subjects were shown the same set of twelve slips of cardboard. However, the subjects were told that the figures would represent the prizes of a class lottery.

Insert Table 1 about here

In all treatments, subjects were required to state complete and strict preference orderings of the twelve income distributions (lotteries) by entering the respective codes into a form with twelve lines ranked from 1 to 12. The code of the most preferred income distribution (for example, "$\bowtie$") had to be entered in the first line, the code of the second preferred one in the second line, etc. Ties were not allowed. Within each treatment, all subjects had to fulfill their tasks simultaneously and anonymously.

After collecting the subjects' responses, five subjects were randomly drawn from each treatment to be eligible for real payoffs in cash. As payoffs we used the amounts of the income distributions divided by 1000, that is, a subject could earn up to €125. This procedure was used to be able to pay substantial amounts to the subjects. Since the experiment was conducted as a classroom experiment no show-up fee had to be paid.

We paid off one group of five randomly selected subjects in each treatment. The average payoff of a selected subject amounted to €36.83 (calculated as the mean of all income distributions). [4] This is about five times

[4] Note that Armantier (2006) showed in a somewhat different context that the random-

the hourly wage of a student (earned within some 30 minutes). Furthermore, the average "loss" due to an erroneous decision (computed as the average absolute loss for all 66 pairwise comparisons of income distributions) is no less than €15.07 (that is, about twice the hourly wage of a student). We conclude from this that our incentive mechanism satisfies Smith's (1982) precepts of saliency and payoff dominance in a sufficient manner. Since there are pros and cons for using monetary incentives in research on theories of income inequality, we think that both approaches, the questionnaire approach using hypothetical income distributions and the experimental approach using real payoffs, are complementary.[5]

The treatments were established by different payoff mechanisms and framings (for examples, see the instructions in the Appendix). Payoffs were immediately paid out in cash.

Lottery treatment First, five subjects were randomly selected for payoff. Second they were randomly assigned to the five prize classes of the lottery such that every prize class was taken. Third, two class lotteries were randomly drawn from the set of the twelve class lotteries. Fourth, we looked at the responses of the five subjects. Each subject was as-

ization of payments did not have a significant effect on subjects' choices as compared to a sure-payment experimental design. Note also that Starmer and Sugden (1991); Beattie and Loomes (1997); and Cubitt, Starmer and Sugden (1998) experimentally demonstrated that the reduction of compound lotteries axiom does not hold, that is, subjects' responses to decision tasks that are embedded in a *random lottery* design are unbiased.

[5]For example, Bernasconi (2002, p. 168) argues in favor of the questionnaire approach because "the size of payoffs which are of natural interest for the theories of income distribution, are obviously not practicable in an experiment". Yet, there is ample experimental evidence (see for example the meta-study by Camerer and Hogarth, 1999), that there is less noise in the data if people are sufficiently compensated for their "cost of thinking" (Shugan, 1980).

signed the prize of his or her prize class of *his or her* more preferred class lottery. This prize was divided by 1000, which yielded the payoff for the particular subject.[6]

Individual-choice treatment First, five subjects were randomly selected for payoff. Second, they were randomly distributed as representatives over the five income quintiles such that every income quintile was taken. Third, two income distributions were randomly drawn from the set of the twelve income distributions. Fourth, we looked at the responses of the five subjects. Each subject was assigned the income of his or her quintile of *his or her* more preferred income distribution. This income was divided by 1000, which yielded the payoff for the particular subject.

Social-preferences treatment First, one subject was randomly selected as social planner. He or she was called to the fore and became visible to all other participants to strengthen his or her social responsibility in face of the whole public.[7] Second, four other subjects were randomly selected. Third, all five selected subjects (including the social planner) were randomly distributed over the five income quintiles so that every income quintile was taken. Fourth, two income distributions were randomly drawn from the set of the twelve income distributions. Fifth, each subject (*including the social planner*) was assigned the income of

[6]Note that the individual-choice approach to social welfare assumes that the decision maker becomes a member of the respective society after having made his or her choice. This requirement is incorporated into the experimental design by assigning subjects randomly to five prize classes and paying out them together (instead of paying out them separately as in a standard individual-choice experiment).

[7]Subjects knew this already at the beginning of the experiment (see the instructions in the Appendix). Our experiment differs in this respect from ultimatum or dictatorship games in which subjects usually stay anonymous.

his or her quintile of the *social planner's* more preferred income distribution. This income was divided by 1000, which yielded the payoff for the particular subject.

Social-planner treatment First, one subject was randomly selected as social planner. He or she was called to the fore and became visible to all other participants to strengthen his or her social responsibility in face of the whole public. Second, five other subjects were randomly selected. Third, the five in step two selected subjects (that is, *excluding the social planner*) were randomly distributed over the five income quintiles so that every income quintile was taken. Fourth, two income distributions were randomly drawn from the set of the twelve income distributions. Fifth, the *social planner's* preferences alone applied for the choice of the preferred income distribution. Each of the five subjects (*excluding the social planner*) was assigned the income of his or her quintile. This income was divided by 1000, which yielded the payoff for the particular subject.

Notice that all subjects reported their preferences of income distributions from behind a veil of ignorance. Communication between subjects was disallowed. Their identity within an income distribution (or lottery) was determined only after they had cast their preferences. All random draws were made in public, so that subjects had no reason to surmise any dependence between the selected income distribution and the probability of ending up in any of the five quintiles. Under the two latter treatments, the social planner's preferences determined the choice of the prevailing income distribution: under the social-preferences treatment he took a stake in the payoff, whereas under the social-planner treatment he was completely uninvolved in monetary terms.

3.2 Income Distributions and Dominance Relations

Section 2 provided a list of dominance relationships surveyed in this paper. Table 2 shows the dominance relationships of our experimental design. As can be gathered from this table, our experimental design contains 15 Pareto rank dominance (PR) relationships, 4 of which are also absolute Pareto dominance (AP) relationships (these are underlined in Table 2), 17 cases of transfer dominance relationships (T), 53 Lorenz dominance (L) relationships and 41 generalized Lorenz dominance relationships (GL).[8] The total number of the respective relationships are again listed in the second column of Table 3 below.

Insert Table 2 about here

Consider, for example, income distributions 1 ("□") and 8 ("▽") in Table 1. Income distribution 8 endows the worst off income recipient with €35,000 which is distinctly more than the €30,000 owned by the best off income recipient in distribution 1. In this example, a violation of absolute Pareto dominance (AP) means that a subject having to choose between income distributions 1 and 8 prefers receiving at maximum €30,000 (distribution 1) over getting at least €35,000 (distribution 8). Apart from simple decision errors, such a seemingly strange behavior could be motivated by a strict focus on the equity aspect. In fact, income distribution 1 guarantees every income recipient the same (low) income, while income distribution 8 distributes the income mass unevenly among the members of the society. This trade off

[8] Recall that, if x Lorenz dominates y and $\mu_x \geq \mu_y$, L also implies GL. These 28 correspondences between L and GL are framed in Table 2. In the remaining 25 and 13 cases, respectively, only one of both dominance relationships applies.

between equity and efficiency is part of the experimental design and applies to all four absolute Pareto dominance relations (see the top of Table 2 for the means and standard deviations of income distributions 1 and 2, and 8 and 9, respectively).

Our experimental design encompasses 15 cases of Pareto rank dominance (PR), including the 4 cases of absolute Pareto dominance. For example, income distributions 3 and 8 constitute a case of Pareto rank dominance as every income recipient in income distribution 8 disposes of more income than the respective income recipient belonging to the same income group in income distribution 3 (€ 35,000 versus € 20,000, € 35,000 versus € 25,000, and so on). Pareto rank dominance, or first-order stochastic dominance, is less transparent than absolute Pareto dominance. We are interested in testing whether the trade-off between efficiency and equity exerts influence on the compliance with Pareto rank dominance. Hence, we designed the income distributions and lotteries such that among the 11 Pareto rank dominance relationships, which were not implied by absolute Pareto dominance, 7 involved a trade-off (8 and 9 versus 3, 4, and 5; 9 versus 7) and the remaining 4 did not. For example, income distribution 10 ("|") is Pareto rank dominated by 8 and it exhibits greater income variance, too. Accordingly, if the acceptance rate of PR is lower for comparisons involving a trade off, this points to equity concerns being given a large weight by the subjects. Otherwise, Pareto dominance violations may be mainly due to decision errors.

Income distributions 2 to 7 are generated from income distribution 1 by mean- and rank-preserving spreads. Consequently, income distribution 1 transfer dominates (T) these income distributions. Altogether, up to 17 possible violations of transfer dominance may arise. Since the respective income distributions all have the same mean, the acceptance of transfer dominance gives an account of the desirability of a uniform income distribution.

While transfer dominance is bound to income distributions having the same mean income, Lorenz dominance neglects mean income. Hence, it is again possible to construct a trade-off between equity (in terms of Lorenz dominance) and efficiency. The experiment permitted up to 53 violations of Lorenz dominance. Among these, 25 dominance relations presented the subjects with a trade-off between equity and efficiency. Take, for example, income distributions 8 and 9: income distribution 8 Lorenz dominates income distribution 9 because its incomes are distributed more evenly (note that this does not necessarily imply a lower standard deviation of incomes). However, income distribution 8 also has the lower mean income (€47,000 versus €48,000). Hence, subjects have to choose between equity (distribution 8) and efficiency (distribution 9). Note also that income distributions 8 and 9 are Rawlsian in terms of maximizing the minimum income.

Generalized Lorenz (GL) dominance takes into account both equity (in terms of the Lorenz curve) and efficiency (in terms of the mean income). 28 of the 41 generalized Lorenz dominance relationships altogether show also Lorenz dominance (L). This corresponds to the case "Lorenz dominance without equity-efficiency trade-off" labelled L^- in Table 3. For example, income distribution 8 ("▽") Lorenz dominates income distribution 3 ("◯") and the mean income of distribution 8 is higher (€47,000 versus €30,000). The remaining 13 cases of generalized Lorenz dominance are of particular interest, because the equity-efficiency trade-off is only solved after multiplying the Lorenz curve with its mean income (see Section 2 above). Take, for instance, income distributions 9 ("—") and 6 ("$\mathbb{X}$"). The Lorenz curves of these income distributions intersect as income distribution 6 exhibits more inequality in the lower tail and less inequality in the upper tail as compared to income distribution 9. On the other hand the mean income of distribution 9 is much higher than the mean income of distribution 6 (€48,000 versus €30,000). Hence, after multiplying the cumulated income share of the income groups with the income distributions' mean incomes, the generalized Lorenz curve of 9 dominates 6.

3.3 Theoretical Background and Research Hypotheses

Our main objective is to study how subjects solve equity-efficiency trade-offs in a ranking task of income distributions, that is, we are interested in comparing whether and how the "weights" that are assigned to the equity and efficiency components in subjects' objective functions differ between the four different treatments. This work – as many other empirical and experimental papers on distributional perceptions – is exploratory in the sense that it focusses on identifying behavioral patterns rather than confirming or rejecting certain theories of income inequality.[9] In this subsection, we want to highlight the differences and special features of the single treatments in order to better understand and interpret the results of the experiment compiled in the next section.

The first distinctive feature of the treatments is the framing of the decision task either as a choice between gambles (lottery treatment) or a ranking of income distributions (individual choice, social preferences, social planner). If risk attitudes and inequality perceptions are closely related (for a thorough discussion of this issue see Cowell and Schokkaert, 2001), other things being equal, the framing of the decision task should not matter.

[9] To a large extent, the relevant theory is normative anyway. High rejection rates of important axioms like the transfer principle certainly do not call into question the basic normative content of the axiom.

In fact, it is possible to separate both concepts. In a recent experiment by Kroll and Davidovitz (2003), groups of subjects (children) were exposed to the same individual risk but allowed to choose between egalitarian and non-egalitarian ex-post distributions of candy bars. In general, the children preferred the egalitarian distribution. Using a questionnaire experiment, Amiel and Cowell (2000) reported that subjects' compliance with the transfer principle was higher in a risk framing than in an inequality framing. Camacho-Cuena et al. (2005) found more preference reversals for income distributions than for lotteries.

Investigating the principle of transfers too, Bernasconi (2002) found that it did not matter for the acceptance of the transfer axiom whether a transfer took place in the top, the middle or the lower tail of the income distribution if subjects were given a pure lottery framing of the decision task. However, in the two treatments that resemble our social-preferences treatment and social-planner treatment, respectively, support for the transfer principle rose significantly when the lower tail of the income distribution was involved.

Thus, Bernasconi (2002) questioned the utilitarian approach to social welfare (Friedman, 1953, Harsanyi, 1953, 1955) to be a meaningful description of distributional preferences. On the other hand, he did not find much support for a non-utilitarian approach like Rawls' (1971) maximin criterion either. Instead, Bernasconi (2002) found some evidence of randomization preferences, that is, a procedural fairness motive (Diamond, 1967; for a discussion of Diamond's critique of Harsanyi's approach see for example, Nzitat 2001). It is in perfect line with this research that a SWF based on randomization preferences was among the top performers in a "beauty contest" of SWFs conducted by Traub et al. (2005). Likewise, the results of Bosmans and Schokkaert (2004) suggest that subjects assigned to the "pure individual risk" scenario were closer to following expected utility or some additive welfare theory than in the other scenarios. As it seems, the ingredient that draws the distinction between pure risk preferences and attitudes towards inequality is some kind of procedural fairness motive based on randomization preferences (Diamond, 1967). In contrast to the consequentialist view of expected utility (Hammond, 1988), the basic notion of procedural fairness implies that people do not only care about final outcomes, but also valuate the procedures leading to outcomes (Frey et al., 2004). According to Rawls (1971), perfect procedural justice is achieved if there are (i) an independent fairness criterion and (ii) a method that guarantees that the fair outcome will be attained.

The theory of social preferences mainly builds on evidence from bargaining experiments and public goods experiments, such as the well-known ultimatum game (Güth et al., 1982). It is a stylized fact of laboratory research that subjects usually reach higher levels of cooperation than predicted by game theory (Holt, 2007). We want to emphasize the fact that the ultimatum game and its relatives involve an outmost sheer veil of ignorance. Subjects know their positions and strategy sets. All remaining uncertainty is *strategic*, that is, due to the lack of knowledge of the actions and beliefs of the others (Van Huyck et al., 1990, 1991). Since the rules of the game are fixed, the fairness motive underlying social preferences cannot be procedural (in terms of choosing a fair allocation procedure), but it must be consequentialist (in terms of proposing a fair allocation).[10] Non-selfish behavior, for instance "fair" half-the-stake offers in the ultimatum game, therefore, has been explained by altruism (Levine, 1998; Andreoni and Miller, 2000; Char-

[10] In the ultimatum game, procedural fairness could be established by randomizing the roles of the proposer and the receiver.

ness and Rabin, 2000), externalities (Bolton, 1991; see also Amiel and Cowell, 1994b), inequity aversion (Fehr and Schmidt, 1999), or reciprocity (Bolton and Ockenfels, 2000). All these approaches have in common that a person's fairness motive in terms of maximizing a SWF of the payoff distribution is mixed with his or her selfish motive in terms of maximizing own payoff. For instance, Charness and Rabin (2002) propose a convex combination of own monetary payoff and a SWF made up of a Rawlsian and a utilitarian SWF. One could entitle this fairness motive "comparative fairness" because it relates the notion of fairness to the social planner's own relative position within the society.

How do "pure risk preferences", "randomization preferences" and "social preferences" translate into research hypotheses concerning equity-efficiency trade-offs? For simplicity, assume we had to allocate one unit of an indivisible good between two identical people (the basic example is due to Diamond, 1967; see also Nzitat, 2001). For the lottery treatment, we would expect a decision maker to exhibit indifference between a lottery that allocates the indivisible good either to person A and nothing to B, or everything to B and nothing to A if it is equally likely that he or she assumes either role. We would also expect the decision maker to be indifferent between the two lotteries and any probability mixture of them, that is, her preferences should satisfy the betweeness axiom which is implied by the independence axiom of expected utility theory (Chew, 1989). A social planner without own stakes in the income distribution who chooses to give the indivisible good either to A or to B would be responsible for having generated a very uneven income distribution. One way of releasing social pressure is to ensure procedural fairness by randomizing the choice between A and B. For instance, the social planner could toss a coin. Though this proceeding may reflect the same aversion against unequal outcomes, it generates an "irregular" preference pattern, because the mixture between A and B is systematically preferred over A and B, that is, it is not consistent with expected utility preferences.

The self-interested social planner – who knows his or her income position – cannot restore fairness by randomizing the income distribution. Yet, in order to achieve a fair outcome, he or she can subsequently share part of his or her benefits with the person who is worse off (if he or she was given the good) or he or she can claim a share of the other person's benefits (if she was not given the good). Extreme outcomes like A and B are very likely to be perceived as being deeply unfair and, hence, would require a lot of redistribution. As redistribution potentially involves a loss of efficiency, the self-interested social planner is from the first expected to put higher weight on equity concerns. Still, he or she is selfish and wants to make the most of the situation. Hence, our hypothesis is that the interference of selfish with social motives induces the decision maker to *avoid extreme outcomes* in terms of very unequal or very equal distributions.

4 Results

4.1 Dominance Relations and Borda Ranks

First, we investigate the compatibility of the subjects' rank orderings of the twelve alternatives with the dominance relations discussed in Section 2. Then, we turn to the ranks of the different alternatives. Table 3 contains the results of our experiment in terms of dominance relations. The first column of Table 3 gives a breakdown of the dominance relations discussed theoretically in Section 2 and visualized by means of the dominance matrix in Table 2: absolute Pareto dominance (AP), Pareto rank dominance (PR), transfer dominance (T), Lorenz dominance (L), and generalized Lorenz dominance (GL). We have added a couple of rows where we take a look at specific subsets of the respective dominance relations. For example, PR \ AP means the subset of Pareto rank dominance relations which are not implied by absolute Pareto dominance. A plus (minus) sign refers to only those dominance relations which (do not) involve an equity-efficiency trade-off. The maximum number of possible individual violations of the dominance relations (Max) is stated in the second column of the table.

For the lottery treatment (L), the individual-choice treatment (I), the social-preferences treatment (P), and the social-planner treatment (S), the table lists the average number of dominance violations per subject (Mean), its standard error (SE), the median number of dominance violations (Median), and the "acceptance rate" (AR) of the dominance relation, that is, the compliance with the dominance relation in per cent ($(1-\text{Mean}/\text{Max}) \times 100$).

Insert Table 3 about here

Table 3 should be studied together with Table 4. Table 4 gives the results of testing on treatment effects, where LIPS denotes the simultaneous test on the equality of treatments L, I, P, and S; row L and column I denotes the test on the equality of treatments L and I; and so on. We applied nonparametric tests (Kruskal-Wallis test and Mann-Whitney-U test, respectively), since the subjects' data did not exhibit a normal distribution.[11] For lack of space, we only report significance levels. Additionally, significance levels are marked

[11]For all treatments and dominance relations, the Kolmogorov-Smirnov goodness-of-fit test rejected normality of the number of dominance violations at least at the 10% significance level. The respective test statistics are omitted in order to save space.

with an asterisk if significant ($p \leq 0.10$). The leading sign indicates the direction of the difference (a + (−) means that the row treatment exhibits more (less) dominance violations than the column treatment).

Insert Table 4 about here

We first present descriptive statistics and test results, giving them an en-bloc interpretation in the next subsection. Absolute Pareto dominance enjoys acceptance rates between 80.3% (P) and 92% (L). Pareto rank dominance performs equally strong. Our tests on treatments effects (Tables 4a to 4e) indicate that subjects exhibit least violations of Pareto dominance in the lottery and individual-choice treatments. Moreover, there are no significant differences between the social-preferences and the social-planner treatments.

In order to clarify whether acceptance rates lower than 100% are driven by equity concerns or simply by decision errors, we concentrate – as explained above – only on the pure Pareto rank dominance relationships with ($PR^+ \setminus AP$) and without ($PR^- \setminus AP$) equity-efficiency trade-off. The results of all within-treatments tests are reported in Table 5. The table lists the respective median number of violations, the Z statistic of a Wilcoxon test, and the significance level of the test. As in Table 4, tests that reject the null hypothesis at the 10% level are marked with an asterisk. After normalizing individual case numbers by the maximum possible number of dominance violations,[12] the Wilcoxon test confirms that the difference between ($PR^+ \setminus AP$) and ($PR^- \setminus AP$) is not significant for any of the treatments.

[12] For each subject, the actual number of dominance violations is divided by the respective maximum possible number of dominance violations.

Insert Table 5 about here

Next, we turn to transfer and Lorenz dominance. The acceptance rates of transfer dominance are relatively low in all treatments; they are highest for the lottery treatment (see Table 3). This is in perfect line with the literature (compare, for example, Amiel and Cowell, 2000; and Gaertner and Namazie, 2003). Table 4f shows that the number of violations of transfer dominance is significantly higher in the social-preferences treatment than in the other treatments. Lorenz dominance scores only slightly better than transfer dominance. Here, acceptance rates are close to 60% in all treatments. Table 4g shows that there are no significant between-treatments differences.

As noted above, 25 Lorenz dominance relationships involved a trade-off between efficiency and equity (L^+). Comparing these with the remaining 28 Lorenz dominance relationships (L^-), including those 17 which are implied by transfer dominance, shows that the two types of Lorenz dominance are perceived as being significantly different (see Table 5): in the lottery treatment, the individual-choice treatment, and the social-planner treatment the acceptance rate of Lorenz dominance is significantly lower if it involves a trade-off with efficiency. We obtain the opposite result for the social-preferences treatment, that is, Lorenz dominance with trade-off achieves a higher acceptance rate than without.

Generalized Lorenz dominance enjoys acceptance rates ranging between 64.5% and 77.4% (see Table 3). Tables 4j and 4k show that L, I, and S are hardly distinguishable from one another, while in the social-preferences treatment the acceptance rate is significantly lower. Comparing the 28 cases of generalized Lorenz dominance implied by Lorenz dominance ($L \cap GL$) with the 13 cases of "pure" generalized Lorenz dominance ($GL \setminus L$) yields the following results (see Table 5): in all four treatments, the acceptance rates are significantly higher in the latter case where the focus is strictly on efficiency.

Now, we cast a look at the aggregate preference ranks of the alternatives. In order to do so, we use the mean and median Borda counts of all 12 alternatives for the three treatments of the experiment. As there are 12 stimuli, the Borda count of income distribution a in treatment t by subject s is given by $B^t_{a,s} := 12 - r^t_{s,a}$, where $r^t_{s,a}$ denotes the rank place (from 1 to 12) assigned to alternative a under treatment $t = \{$L (lottery), I (individual choice), P (social preferences), and S (social planner)$\}$ by subject s, that is, the Borda count for the "best" alternative is 11 while it is 0 for the worst. Table 6 lists the mean incomes, coefficients of variation, and mean and median Borda counts of the 12 income distributions used as stimuli. We report the coefficient of variation here in order to make the dispersion of incomes comparable between income distributions exhibiting different mean incomes.

Insert Table 6 about here

Computing bivariate Spearman rank correlations of the median ranks of the alternatives for the four treatments yields the following results: the "neutral" lottery treatment exhibits relatively low rank correlations (I: 0.645, P: 0.389, S: 0.645). Interestingly enough, the individual choice treatment which is except for the framing identical to treatment L yields much higher correlation coefficients with the other two treatments (P: 0.794, S: 0.943). Finally, the correlation between social preferences and social-planner treatment is 0.794. To sum up, we find strong similarity between the Borda rankings produced by the individual choice treatment and the social-planner treatment, we find relatively weak correlation between the neutral framing and the income-distribution framing, in particular with the social-preferences treatment.

Consider income distributions 1 to 7 only: these are the income distributions having the same mean income (recall that income distributions 2 to 6 are mean preserving spreads of income distribution 1). For strictly inequality (risk) averse subjects we would, thus, expect the preference ordering $1 \succ 2 \succ 5 \succ 3 \succ 4 \succ 7 \succ 6$. In fact, we find a rank correlation between this hypothetical preference ordering and the rank ordering of the lottery treatment of 0.964, that is, strong evidence of risk aversion. For the individual-choice treatment, the figure is somewhat lower (0.793) but still significant at the 10% level. The social-planner treatment exhibits an insignificant correlation of 0.593. The social-preferences treatment stands out with a rank correlation of $-.018$, which is mainly due to the poor ranking of alternative 1.

Insert Table 7 about here

Interestingly enough, Table 7 shows that the equal distribution of incomes (income distribution 1) is ranked significantly lower in treatment P than in the other treatments, while income distribution 3, which exhibits an intermediate degree of inequality, is ranked much better. In other words, without income distribution 1, subjects in treatment P would be *more* inequality (risk) averse than in the other treatments.

Considering all 12 income distributions, we find that alternatives 9 and 8 which promise a relatively high mean income combined with a low coefficient of variation exceed the other alternatives in their ratings. In the social-preferences treatment subjects rank alternative 12, which is the only alternative with a zero income entry, significantly worse than in the individual-choice and social-planner treatments. In sharp contrast to this, in the lottery treatment, this alternative is given a Borda rank of 9. This picture is confirmed by the respective Mann-Whitney U and Kruskal Wallis tests (see Table 7).

In the context of decision making under risk, experiments have shown that women are in general more risk averse than men (for a literature review see Powell et al., 2001). Hence, we also tested our data for gender-differences (in each treatment, about one third of subjects was female). The overall picture stays the same when investigating male and female subjects separately. However, in the individual-choice and the social-planner treatment, female subjects rank the perfectly-equalizing alternative 1 significantly higher than male subjects (Mann-Whitney-U test: individual choice $Z = 2.610$, $p = 0.009$; social planner $Z = 2.043$, $p = 0.041$). Moreover, in both treatments, female subjects evaluate alternative 12, the one with a zero income entry, significantly worse than male subjects (individual choice $Z = 1.844$, $p = 0.064$; social planner $Z = 1.973$, $p = 0.049$). Gender-difference did neither occur in the lottery treatment nor in the social-preferences treatment.

4.2 Discussion

We interpret the evidence presented in the previous subsection as follows: The relatively low number of violations of absolute Pareto dominance and Pareto rank dominance, together with the lack of within-treatment differences between dominance relations involving and not involving an equity-efficiency trade-off, suggests that both types of violations of Pareto dominance are mainly due to *decision errors*. This interpretation is supported by the fact that subjects were most successful in detecting Pareto dominance relations in the lottery and the individual-choice treatments, where they had to focus only on their own payoffs. Apart from this, the subjects' success in detecting Pareto dominance relationships also suggests that the subjects on average made deliberate decisions and did not resort to simple rules of thumb or decision heuristics.[13]

Except for the lower error rate with respect to Pareto rank dominance, we found no significant differences between individual-choice treatment and social-planner treatment. Contrary to our initial assumption that the individual-choice treatment would mimic a Friedman-Harsanyi scenario, the framing as a ranking task of income distribution seems to have induced our subjects to act as if they were in a social-planner scenario. Hence, we re-conducted the scenario as a neutrally framed lottery treatment. Note that individual-choice treatment and social-planner treatment were the only treatments exhibiting gender effects, with a tendency towards more inequality aversion among female subjects.

In our interpretation, the relatively low acceptance rate of transfer dominance in all treatments indicates that a considerable number of subjects exhibits randomization preferences.[14] This interpretation is supported by the fact that the number of violations of transfer dominance was lowest in the lottery treatment and it was highest in the social-preferences treatment. The social-planner treatment was intermediate. This observation is fortified

[13]We did not omit subjects because there was no "right" or "wrong" solution of the decision task.

[14]At large, violations of transfer dominance may, for example, also be interpreted as an expression of (slight) preferences for inequality or, as noted by Amiel and Cowell (1999a), people are concerned about the overall structure of income distributions rather than only the incomes of the individuals involved in the transfer.

by the Borda rankings of alternatives 1 to 7 (alternatives 2 to 7 being mean preserving spreads of alternative 1). In the lottery treatment, the ranking of an average subject was almost identical to the ranking that would have been produced by a hypothetical risk-averse expected-utility maximizer. In the social-preferences treatment, the ranking of the average subject was utterly inconsistent with expected-utility preferences.

Our results concerning Lorenz dominance and generalized Lorenz dominance indicate that efficiency considerations were generally given a greater weight than equity considerations in all treatments. While this observation may be influenced by the choice of the experimental income distributions and lotteries, the within-treatments tests clearly show that the social-preferences treatment stands out again. Here, in contrast to the other treatments, Lorenz dominance is a more accepted principle if it involves an equity-efficiency trade-off than if it does not.

We attribute the fact that the weight of the equity component is amplified in the social-preference treatment to a "comparative fairness" motive. This is nicely reflected by the strong opposition to the perfectly equalizing income distribution (which does not allow the self-interested social planner to be different from the other members of the society) and the income distribution involving an income of zero (which holds the risk of ending up in a very deprived situation).

Similar experimental setups were previously employed by Bernasconi (2002) and Bosmans and Schokkaert (2004), though the main focus of their work was on the compliance of subjects' choices with the standard properties of EUT. Our research complements these studies with a focus on how people solve equity-efficiency trade-offs. We find the same pattern that the lottery treatment is more compatible with expected-utility preferences and that the treatments concerned with inequality exhibit more "irregular" behavior in terms of a procedural fairness motive. Our main finding could be called that if selfish and fairness motives interfere with each other, this leads to the avoidance of extremely equal and extremely unequal (involving zero payoffs) outcomes, even if this attitude is at the expense of efficiency.

5 Conclusions

We experimentally studied how subjects solve equity-efficiency trade-offs in a ranking task of income distributions. In particular, we were interested in knowing whether and how the "weights" that are assigned to the equity and efficiency components in the subjects' objective functions differ between different treatments. Four treatments have been considered: lottery treatment, individual-choice treatment, social-preferences treatment, and social-planner treatment. We reported our results in terms of the Borda counts of the income distributions and a between-subjects analysis of the subjects' compliance with dominance relationships that focus exclusively on the efficiency aspect (Pareto dominance), the equity aspects (transfer dominance and Lorenz dominance), or on both aspects of income distributions (generalized Lorenz dominance).

As in previous studies by Bernasconi (2002) and Bosmans and Schokkaert (2004), the lottery treatment outperformed the other treatments with respect to its compatibility with the expected-utility model. Significant treatment effects occurred with respect to transfer and Lorenz dominance: in the social-preferences treatment, subjects were more inequality averse than in the other treatments. At the same time, they strongly rejected both a perfectly equalizing distribution and a distribution that involved an income of zero.

Our results highlight structural differences between risk attitude, perception of inequality, and social preferences. The pure risk attitude that is extracted from the Friedman-Harsanyi scenario (Friedman, 1953; Harsanyi, 1953, 1995) does not adequately reflect people's attitudes towards inequality from behind a veil of ignorance. As it seems, the pure social planner (Dalton, 1920; Atkinson 1970) is guided by a procedural fairness motive – randomization preferences (Diamond, 1967) – rather than risk aversion. If the veil of ignorance becomes thinner and people are given the possibility to compare their own potential income position with the income position of other people, a "comparative fairness" motive comes to the fore: the self-interested social planner attaches greater importance to establishing an income distribution that is equitable enough not to be protested but still allows to outperform the others. Hence, our results support recent experimental evidence on social preferences (Andreoni and Miller, 2002; Bolton and Ockenfels, 2000; Charness and Rabin 2002; and Fehr and Schmidt, 1999; Fehr and Schmidt, 2003).

Acknowledgements

We thank an associate editor of the European Economic Review and two anonymous referees for their comments and suggestions. Financial Support of the European Commission under TMR Contract No. ERBFMRXCT98-0248 is gratefully acknowledged. We are indebted to Serge-Christophe Kolm, Alf Erling Risa, Peter Zweifel, and to the participants of the Bocconi workshop for helpful comments. The usual disclaimer applies. The data is available from the corresponding author on request.

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Appendix: Instructions

[treatments I, P, S only] The evaluation of income distributions is a fundamental issue in economics. Assume, for example, the government wants to decrease the highest income tax rate. Possibly, this could lead to a higher mean income as well as a more unequal income distribution, i.e., the rich gain more than the poor. Whether this development is good or bad cannot be said without involving value judgements, i.e., this is a question of personal beliefs and attitudes.

[all treatments] In the following experiment, we would like to assess your personal attitudes towards [I,P,S] income distributions ([L] lotteries). We will present you 12 different [I,P,S] income distributions ([L] lotteries). Your task is to rank these [I,P,S] income distributions ([L] lotteries) according to your personal preferences. [I,P,S] For each income distribution, it is assumed that the income earners fall into five equally large groups of 20% of the population, where every income recipient within a group has the same income. This means that each income distribution can be represented by five income values which state the respective net incomes of the single group members. ([L] Each lottery has five prize classes which are equally likely, i.e. there is a 20% chance to end up within a specific class.) The 12 different [I,P,S] income distributions ([L] lotteries) are depicted in this table [experimenter shows table].

Treatment L: Lotteries

For partaking in our experiment you will be rewarded. Five participants will be given a payoff. Among all answer sheets we will draw five participants. Each of these five participants will be assigned randomly to one of the prize classes such that each of the five classes is taken. After that, two lotteries will be drawn randomly. The five selected participants are given that amount of money as payoff which corresponds to the prize class in Euros divided by 1000 of their preferred lottery.

Example: Your are randomly assigned to outcome class three. The randomly drawn lotteries are "circle" and "giveway". If you have ranked "circle" higher than "giveway", you will be given €30, €50 otherwise.

Treatment I: Individual Choice

For partaking in our experiment you will be rewarded. Five participants will be given a payoff. Among all answer sheets we will draw five participants. Each of these five participants will be assigned randomly to one of the five income groups such that each of the five groups is taken. After that, two income distributions will be drawn randomly. The five selected participants are given that amount of money as payoff which corresponds to the income value in Euros divided by 1000 of their preferred income distribution.

Example: Your are randomly assigned to income group three. The randomly drawn income distributions are "circle" and "giveway". If you have ranked "circle" higher than "giveway", you will be given €30, €50 otherwise.

Treatment P: Social Preferences

For partaking in our experiment you will be rewarded. Five participants will be given a payoff. Among all answer sheets we will draw a social planner, who will have to come to the fore and, therefore, is visible to all other participants. The social planner determines the income distribution to be applied for payoff. This will work as follows: two income distributions will be selected randomly and, among these, the income distribution is chosen which has been ranked higher by the social planner. After that four further participants will be chosen randomly. The social planner and the four participants will be assigned randomly to the five income groups such that each of the five groups is taken. The selected participants, including the social planner, are given that amount of money as payoff which corresponds to the income value in Euros divided by 1000 of the income distribution preferred by the social planner. Thus, the income distribution chosen by you determines not only your own payoff but also the payoffs of the other selected participants.

Example: The randomly drawn income distributions are "circle" and "giveway". If the social planner has ranked "circle" higher than "giveway", the person who has been assigned to the first income group will be given €20, the person who has been assigned to the second group €25, the third group €30 and so on. Otherwise, if the social planner has ranked "giveway" higher than "circle", the member of the first group will be given €35, the second group €35 and so on.

Treatment S: Social Planner

For partaking in our experiment you will be rewarded. Five participants will be given a payoff. Among all answer sheets we will draw a social planner, who will have to come to the fore and, therefore, is visible to all other participants. The social planner him- or herself will not get any payoff; yet he or she determines the income distribution to be applied for payoff. This will work as follows: two income distributions will be selected randomly and, among these, the income distribution is chosen which has been ranked higher by the social planner. After that five participants will be chosen randomly. The five participants will be assigned randomly to the five income groups such that each of the five groups is taken. The selected participants are given that amount of money as payoff which corresponds to the income value in Euros divided by 1000 of the income distribution preferred by the social planner. The social planner will not get any payoff. Thus, the income distribution chosen by you determines only the payoffs of the other participants.

Example: The randomly drawn income distributions are “circle” and “giveway”. If the social planner has ranked “circle” higher than “giveway”, the person who has been assigned to the first income group will be given €20, the person who has been assigned to the second group €25, the third group €30 and so on. Otherwise, if the social planner has ranked “giveway” higher than “circle”, the member of the first group will be given €35, the second group €35 and so on.

Tables

Table 1 Stimulus material of the experiment

No.	Symbol	Name	Income distribution
1	□	square	(30,000 30,000 30,000 30,000 30,000)
2	◇	diamond	(25,000 27,500 30,000 32,500 35,000)
3	◯	circle	(20,000 25,000 30,000 35,000 40,000)
4	+	cross	(20,000 20,000 30,000 40,000 40,000)
5	⋈	bowtie	(20,000 30,000 30,000 30,000 40,000)
6	𝕏	swords	(5,000 10,000 30,000 50,000 55,000)
7	△	triangle	(5,000 30,000 30,000 30,000 55,000)
8	▽	giveway	(35,000 35,000 50,000 55,000 60,000)
9	—	horline	(35,000 35,000 35,000 45,000 90,000)
10	|	verline	(7,500 7,500 50,000 55,000 60,000)
11	⧖	sandglas	(7,500 7,500 35,000 45,000 90,000)
12	⊠	crossbox	(0 30,000 40,000 125,000 125,000)

Table 2 Dominance structure

	1	2	3	4	5	6	7	8	9	10	11	12
μ	30,000	30,000	30,000	30,000	30,000	30,000	30,000	47,000	48,000	36,000	37,000	64,000
σ	0	3,536	7,071	8,944	6,324	20,248	15,811	10,295	21,354	23,484	30,389	51,517
1	—	T,L,GL	T,L,GL	T,L,GL	T,L,GL	T,L,GL	T,L,GL	L	L	L	L	L
2		—	T,L,GL	T,L,GL	L,GL	T,L,GL	L,GL	L	L	L	L	L
3			—	T,L,GL		T,L,GL	L,GL			L	L	L
4				—		T,L,GL	L,GL			L	L	L
5			T,L,GL	T,L,GL	—	T,L,GL	T,L,GL			L	L	L
6						—						L
7						T,L,GL	—					L
8	<u>PR</u>,GL	<u>PR</u>,GL	PR,L,GL	PR,L,GL	PR,GL	PR,L,GL	PR,L,GL	—	L	PR,L,GL	L,GL	L
9	<u>PR</u>,GL	<u>PR</u>,GL	PR,GL	PR,GL	PR,GL	GL	PR,GL		—	GL	PR,L,GL	L
10						GL				—	L	
11						GL					—	
12												—

Table note. Alternative (row) dominates alternative (column) by criterion k, where k = PR (Pareto rank dominance), T (transfer principle), L (Lorenz dominance), GL (generalized Lorenz dominance); if PR is underlined, AP (absolute Pareto dominance) applies too. The framed areas mean that L satisfies also GL. The figures in the head of the table give the means μ and standard deviations σ of the respective income distributions.

Table 3 Dominance relations

		L		I		P		S	
Dominance Relation	Max	Mean SE	Median AR	Mean SE	Median AR	Mean SE	Median AR	Mean SE	Median AR
AP	4	.32	0	.40	0	.79	0	.62	0
		.13	92%	.13	90%	.15	80.3%	.16	84.5%
PR	15	1.11	0	1.23	0	2.85	0	2.62	0
		.45	92.6%	.38	91.8%	.49	81%	.55	82.5%
PR $\setminus$ AP	11	.78	0	.83	0	2.07	0	2.00	0
		.32	92.9%	.27	92.5%	.37	81.1%	.43	81.8%
$PR^+ \setminus$ AP	7	.51	0	.57	0	1.43	0	1.33	0
		.22	92.7%	.20	91.9%	.28	79.6%	.29	81%
$PR^- \setminus$ AP	4	.28	0	.27	0	.64	0	.67	0
		.11	93.0%	.11	93.3%	.15	84%	.16	83.3%
T	17	5.91	5	7.18	6	9.25	9	6.53	6
		0.57	65.2%	.63	57.8%	.58	45.6%	.61	61.6%
L	53	21.38	18	18.88	16	20.52	17	20.18	18
		1.39	59.7%	1.49	64.4%	1.31	61.3%	1.58	61.9%
L^+ (L $\setminus$ GL)	25	13.58	13	10.22	8	9.00	8	11.20	9
		.94	45.7%	0.83	59.1%	0.75	64%	0.94	55.2%
L^- (L $\cap$ GL)	28	7.80	6	8.67	7	11.52	11	8.98	7
		.77	72.1%	0.83	75%	0.78	58.9%	7.00	67.9%
GL	41	9.25	7	10.20	9	14.54	13	11.58	10
		1.00	77.4%	1.01	75.1%	1.94	64.5%	1.18	71.8%
GL $\setminus$ L	13	1.45	0	1.53	0	3.02	2	2.59	1
		.41	88.8%	.33	88.2%	.39	76.8%	.49	80.1%

Table note. n(L) = 65, n(I) = 60, n(P) = 61, n(S) = 66. Max(imum), Mean and Median number of domination violations. SE: standard error of the mean. AR: overall acceptance rate.

Table 4 Between-treatments tests of dominance relations

a) AP

	I	P	S
L	−.386	−.002*	−.047*
I	—	−.023*	−.272
P		—	+.201
	LIPS .009*		

b) PR

	I	P	S
L	−.393	−.000*	−.001*
I	—	−.001*	−.020*
P		—	+.318
	LIPS .000*		

c) PR \ AP

	I	P	S
L	−.378	−.000*	−.003*
I	—	−.001*	−.031*
P		—	+.306
	LIPS .000*		

d) PR^+ \ AP

	I	P	S
L	−.183	−.000*	−.004*
I	—	−.009*	−.077*
P		—	+.477
	LIPS .001*		

e) PR^- \ AP

	I	P	S
L	+.930	−.027*	−.067*
I	—	−.026*	−.059*
P		—	−.788
	LIPS .038*		

f) T

	I	P	S
L	−.152	−.000*	−.581
I	—	−.014*	+.499
P		—	+.001*
	LIPS .001*		

g) L

	I	P	S
L	+.137	+.678	+.428
I	—	−.254	−.671
P		—	+.599
	LIPS .501		

h) L^+ (L \ GL)

	I	P	S
L	+.014*	+.001*	+.058*
I	—	−.343	−.542
P		—	−.156
	LIPS .006*		

i) L^- (L ∩ GL)

	I	P	S
L	−.433	−.001*	−.517
I	—	−.008*	−.984
P		—	+.014*
	LIPS .005*		

j) GL

	I	P	S
L	−.386	−.000*	−.166
I	—	−.001*	−.601
P		—	+.012*
	LIPS .000*		

k) GL \ L

	I	P	S
L	−.262	−.000*	−.024*
I	—	−.001*	−.214
P		—	+.042*
	LIPS .000*		

Table note. n(L) = 65, n(I) = 60, n(P) = 61, n(S) = 66. Sign of the difference (row, column) and significance level of a Man-Whitney U test (Kruskal Wallis test). A test is marked with an asterisk if $p \leq 0.10$.

Table 5 Within-treatments tests of dominance relations

	$PR^+ \setminus AP$ $PR^- \setminus AP$		L^+ L^-		$GL \setminus L$ $L \cap GL$	
	Median Median	Z p	Median Median	Z p	Median Median	Z p
L	0	.406	14.56	5.320	0	4.927
	0	.684	6	.000*	6	.000*
I	0	.561	8.96	3.213	0	5.098
	0	.575	7	.001*	7	.000*
P	0	1.071	8.96	2.263	4.31	4.690
	0	.284	11	.024*	11	.000*
S	0	.972	10.08	3.312	2.15	3.559
	0	.331	7	.001*	7	.000*

Table note. n(L) = 65, n(I) = 60, n(P) = 61, n(S) = 66. Median number of violations, Z statistic and significance level of a Wilcoxon test. A test is marked with an asterisk if $p \leq 0.10$. Case numbers are normalized for the maximum number of dominance violations.

Table 6 Average and median Borda counts

	Mean	Coefficient	L		I		P		S	
No.	income	of variation	Mean	Med	Mean	Med	Mean	Med	Mean	Med
1	30,000	0	6.22	7	5.55	6	3.16	1	5.30	6
2	30,000	0.118	5.42	6	6.38	7	6.70	7	5.88	6
3	30,000	0.236	4.78	5	6.45	6	8.07	8	6.03	6
4	30,000	0.298	4.86	5	5.32	5.5	5.69	6	5.48	5
5	30,000	0.211	4.89	5	5.02	5	5.64	6	5.89	7
6	30,000	0.675	2.89	2	3.52	2	4.74	4	3.38	2
7	30,000	0.527	3.40	3	3.03	2.5	3.34	3	3.62	2.5
8	47,000	0.219	9.25	10	9.40	10	8.92	10	8.65	10
9	48,000	0.445	9.55	10	9.67	10	8.51	10	8.80	10
10	36,000	0.652	3.88	4	4.05	3.5	4.77	5	4.06	3
11	37,000	0.821	4.43	3	4.28	4	5.25	4	4.88	4.5
12	64,000	0.805	6.43	9	3.37	1	1.20	0	4.02	2

Table note. $n(\text{L}) = 65$, $n(\text{I}) = 60$, $n(\text{P}) = 61$, $n(\text{S}) = 66$.

Table 7 Between-treatments tests of Borda counts

	a) Distribution 1 (Square)				b) Distribution 3 (Circle)				b) Distribution 12 (Crossbox)		
	I	P	S		I	P	S		I	P	S
L	+.405	+.000*	+.138	L	−.000*	−.000*	−.006*	L	+.001*	+.000*	+.003*
I	—	+.000*	−.612	I	—	−.000*	−.383	I	—	+.000*	−.607
P		—	−.002*	P		—	−.000*	P		—	−.000*
	LIPS .000*				LIPS .000*				LIPS .000*		

Table note. n(L) = 65, n(I) = 60, n(P) = 61, n(S) = 66. Sign of the difference (row, column) and significance level of a Man-Whitney U test (Kruskal Wallis test). A test is marked with an asterisk if $p \leq 0.10$.