INCOME DISTRIBUTIONS VERSUS LOTTERIES: HAPPINESS, RESPONSE-MODE EFFECTS, AND PREFERENCE REVERSALS

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Abstract

This paper provides a comparative experimental study of income distributions and risky prospects. We observe that Lorenz dominance is satisfied for the ratings of distributions, while the opposite holds for lotteries, Distributions whose Lorenz curve cuts others from below exhibit also higher ratings; the opposite holds again for lotteries. The rating of income distributions is a decreasing function of standard deviation, lottery rating is a decreasing function of skewness. The equally distributed equivalent income is an increasing function of standard deviation, skewness, and kurtosis, the certainty equivalent is an increasing function of standard deviation and kurtosis. Preference reversals are found in about half of all cases. The transfer principle is largely violated. Ethical inequality measures lack support in peoples' perceptions.

KEYWORDS: Income Distribution, Lotteries, Income Happiness, Inequality and Risk Aversion, Ethical Inequality Measures, Preference Reversal

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1 Introduction

Many scholars have recognized the close relationship between risky prospects and income distributions. For instance, Kolm (1969) and Atkinson (1970) established the concept of the equally distributed equivalent income [EDE] by analogy with the certainty equivalent [CE] of a lottery.[1] Instead of applying results from the theory of risky prospects to income distributions, some authors took the other way round, to wit, they applied tools taken from the analysis of income distributions to the analysis of risky prospects. It was, in particular, Lopes (1984, 1987) who put Lorenz curves to good use to study lottery experiments.[2]

Following Friedman's (1953) lead, other scholars, in particular Strotz (1958, 1961) and Kanbur (1979, 1982), have modelled the emergence of income distributions as a resultant of decisions under risk. Still other scholars modelled the welfare evaluations of income distributions in terms of expected utility.[3] Other scholars showed the equivalence of social welfare functions and income inequality measures.[4]

Income happiness has been studies in a number of ways, first, using field data for time–series and cross–section investigations, second, employing experiments to observe the happiness pattern generated by divers payoff struc-

[1]Cf. also Rothschild and Stiglitz (1970, 1971, 1973), and, for a generalized presentation, Nermuth (1993).

[2]Curiously enough, Lopes (1984), p. 481, went even so far as to reconvert the parameter ε of Atkinson's inequality measure into a measure of subjects' risk attitudes, which the economist readily identifies as the Arrow-Pratt measure of relative risk aversion.

[3]Cf., e.g., Vickrey (1945, 1960, 1961), Fleming (1952), Goodman and Markovitz (1952), Harsanyi (1953, 1955), Dworkin (1981) Dahlby (1987), Kolm (1985, 1998), Epstein and Segal (1992), Fleubaey (1998).

[4]Cf., e.g., Blackorby and Donaldson (1978), Cowell (1985), Cowell and Kuga (1981), Chakravarty (1990), Blackorby, Bossert, and Donaldson (2001).

tures, and, third, by canvassing the happiness bred by different distributional shapes. Time–series investigators have shown constant mean happiness ratings in the lapse of time, even across periods of vigorous income growth, and a distinct positive correlation of happiness and income for cross–section analyses.[5] Moreover, it seems that, in the course of time, subjects put up with their (un)fortunate fate: Brickman, Coates, and Janoff–Bulman (1978) did not observe major differences in the reported happiness of the winners of top lottery prizes and paraplegics, respectively, when compared with control groups. Of course, adaptation takes place only after a longer spell.

Thus, the lesson of field data shows us that *relativity* matters for income happiness. This has by and large been confirmed by experimental research. Loewenstein, Thompson, and Bazerman (1989) and, in particular, Bazerman, Loewensein, and White (1992) observed that, in the space of payments to self and one other person, subjects rate a more equal payoff distribution higher, even if it implies inferior payments for self than a more unequal distribution.[6] This attitude demonstrates a robust violation of the Pareto principle, which caused McClelland and Rohrbaugh (1978) to entitle their paper with the question "Who Accepts the Pareto Axiom?"

These findings readily translate into happiness in the workplace, endowed, however, with a preference inversion between happiness perception and job

[5]Cf., e.g., Easterlin (1974, 1995, 2001), Duncan (1975), Smith (1979), Veenhoven (1993), Kenney (1999), Blanchflower and Oswald (2000), Diener and Oishi (2002). Notice, however, that questions posed within happiness polls may be severely impaired by framing effects; for a striking example cf. Turner and Krauss (1978).

[6]For similar findings cf. also Conrath and Deci (1969), Radzicki (1976), McClelland and Rohrbaugh (1978), Rohrbaugh, McClelland, and Quinn (1980), Messick and Sentiy (1985), Charness and Grosskopf (2001) observe a negative correlation of happiness and willingness to lower another person's payoff below one's own. For contrary results cf. Hoffman and Spitzer (1982, 1985) and van Avermaet (1974).

choice. Subjects express greater happiness for jobs with less pay when salaries are more equally distributed than for jobs with more pay which falls off from their mates' salaries. At the same time, when faced with job choices, subjects opt for the higher–paid job, accepting thus some relative deprivation resulting from the unequal salaries.[7] Tversky and Grifin (1991) explain this behavior as the resultant of two countervailing effects, viz. the endowment effect (depending on the quality and the intensity of an event), and the contrast effect (depending on an event's similarity with or relevance for other events).

> It seems that judgments of well–being are insufficiently sensitive to endowment, whereas choice is insufficiently sensitive to contrast. The exclusive reliance on either method can lead to unreasonable conclusions and unsound recommendations. Welfare policy derived from Pareto optimality could result in allocations that make most people less happy because it ignores the effect of social comparison. On the other hand, a preoccupation with judgment has led some psychologists to the view ... [which is] justified only if endowment effects are essentially ignored. [Tversky and Griffin (1991), p. 117]

This last remark leads to the claim of Parducci that happiness results from the shape of the distribution:

> What the theory suggests is that happiness is a negatively skewed distribution. If the best can come only rarely, it is better not to include it in the range of experiences at all. The average level of happiness can be raised by arranging life so that high levels of satisfaction come frequently, even if this requires renunciation of the opportunity for

[7]Cf., e.g., Schmitt and Marwell (1972), Ross and McMillen (1973), Austin, McGinn, and Susmilch (1980), Tversky and Griffin (1991), Blount and Bazerman (1996). Clark and Oswald (1996) observed related results for British field data.

occasional experiences that would be even more gratifying. [Parducci (1968), p. 90]

Let us now draw attention to a response–mode phenomenon in the evaluation of lotteries, viz. to *preference reversal.* It was discovered by Lichtenstein, Lindman, and Slovic.[8] The experimental design to demonstrate preference reversal is quite easy: There are two lotteries, a so–called P–bet, which accords a modest payoff with a high probability, and a so–called $–bet, which accords a high payoff with a low probability. A substantial fraction of subjects express preference for the P–bet, but assign a higher CE (usually measured in terms of a selling price) to the $–bet.

In spite of the close relationship between risky prospects and income distributions, there exists hardly any general, systematic, and joint analysis of income distributions and risky prospects. We pick several problems which await answers.

First, does the well–documented preference reversal phenomenon of risk analysis carry over to response–mode effects of income distributions? In other words, do observational inconsistencies exist between preferences among income distributions and their associated EDE's? To illustrate, suppose x and y denote two income distributions arranged in nondecreasing order with the same mean and in the same dimension. Let $\succsim$ denote a subject's preference or happiness relation in the space of income distributions. Then we would expect

$$\mathrm{EDE}(x) \geqslant \mathrm{EDE}(y) \Leftrightarrow x \succsim y. \tag{1}$$

In terms of the Atkinson–Kolm–Sen terminology, $\succsim$ is expressed as a ho-

[8] Lindman (1965, 1971), Slovic and Lichtenstein (1968), Lichtenstein and Slovic (1971). For a comprehensive literature survey cf. Seidl (2002).

mothetic social welfare function.[9] Now, if (1) is violated, that is, if preference reversal haunts income distributions in a similar way as it haunts risky prospects, then ethical measures of inequality become devoid of any perceptional bedrock.

Second, the experimental stimuli of virtually all experiments of income happiness and preference reversal consist of binary relations, i.e., payments to self and other to study happiness of income distributions,[10] and binary lotteries to test preference reversal.[11] Yet binary income distributions cannot claim relevance beyond a Robinson–and–Friday world, and risky events are seldom dichotomous beyond the laboratory, but consist of multiple outcomes.

[9]For nonhomothetic social welfare functions relation (1) continues to hold if we choose a reference welfare level w such that $W(x) \geqslant w \geqslant W(y)$. For technical details cf. Blackorby and Donaldson (1978), p. 64.

[10]The binary concept of inequality aversion as developed by Loewenstein, Thompson, and Bazerman (1989) was generalized by Fehr and Schmidt (1999), p. 822, to the n–person case, but has not yet been tested in experiments. Bolton and Ockenfels (2000) model a subject's utility as a function of own absolute payoff and his or her share in total payoffs, but not as a function of payoff distribution. Similar ideas were developed by philosopher Temkin (1986, 1993). Temkin suggests that inequality aversion results from the complaints of income recipients in an income distribution akin to realitve deprivation. Levine's (1998) model aims at an explanation of altruism and spitefulness rather than at a modelling and a test of income happiness.

[11]Combining high lottery payoffs with bid prices, Casey (1991) observed reverse preference reversals. Using an experimental design akin to that one developed by Schneider and Lopes (1986) and Lopes (1984, 1987), Casey employed multi–outcome lotteries. He generalized the P–bet as a negatively skewed Distribution and the \$–bet as a positively skewed distribution, but, as he, other than Weber (1984), did not observe major differences from binary lotteries [Casey (1991), p. 237], he did not resume working with multi–outcome lotteries in his second experiment. He reports (p. 232) that Weber (1984) had found distinctly less preference reversals for three–outcome bets. However, this pattern did not show up in the Casey experiment.

Analyses of income happiness by way of field data do not investigate subjects' emotions vis–à–vis income distributions, but consider either subjects' relative position across income echelons, or with respect to a reference point, such as mean income. Multi–outcome lotteries, it is true, have been pioneered by Schneider and Lopes, but they used them either to critically re–examine the reflection effect [Schneider and Lopes (1986)], or to investigate subjects' risk attitudes [Lopes (1984, 1987)]. The possibility of a joint analysis of income distributions and risky prospects was ignored.

Third, material incentives seem to have never been used in experiments on income distributions.[12] Although Camerer and Hogarth (1999) provided evidence that the role of material incentives seems to have been overstated by economists,[13] the complete absence of material incentives is alarming, because, if they matter for income distributions, there is no chance of detecting this dependence, as they were never applied.

Fourth, the influence of the shape of the income distribution on subjects' happiness (in particular, Parducci's conjecture that negatively skewed distributions breed happiness) seems to have never been experimentally investigated in a systematic way. In order to do this, the endowment effect and the contrast effect [Tversky and Griffin (1991)] have to be disentangled, and the contrast effect has to be isolated. This requires to analyze the shapes of different income distributions with the same total income and the same

[12] Cf., e.g., Amiel and Cowell (1992, 1994a,b, 1998, 199a,b), Harrison and Seidl (1994a,b), Amiel, Cowell, and Polovin (2001), Bernasconi (2002). Exceptions are the papers by Traub, Seidl, Schmidt, and Levati (2001), and by Schmidt, Seidl, Traub, and Levati (2001), but these two papers are still unpublished.

[13] Psychologists do not consider material incentives as the hub of a decent experimental design, they often award course credits to their subjects, which may well substitute monetary payoffs.

number of income recipients.

Fifth, joint analyses of risky prospects and income distributions are much in their infancy.[14] Amiel and Cowell (1999b) and Amiel, Cowell, and Polovin (2001) asked their subjects to compare income distributions of the following kind

$$(a, 0.5, b) \quad \text{and} \quad (b, 0.5, c), \quad 0 < a < b < c, \tag{2}$$

indicating that half of the subjects have the lower income, the other half has the higher income. The parameters a, b, and c were chosen so as to mimic a translation, a scale transformation, and an intermediate transformation. Whereas Amiel and Cowell (1999b, p. 229) asked their subjects to state which distribution they considered as *more unequally distributed*, Amiel, Cowell, and Polovin (2001, p. 974) asked which distribution subjects considered to be *more risky* to a potential migrant in the respective countries.

It seems to us that only the first question makes sense. The second question compares lotteries or income distributions of which the second strictly dominates the first. It is hard to see why a situation should be perceived as less risky in which a subject can only lose, but never win, irrespective of which state of the world occurs. In a comparative situation psychologist Lopes (1987, p. 266), being less preoccupied with traditional lore than economists, has characterized the second lottery as *riskless* because it guarantees a sure payoff amounting to the maximum payoff of the first lottery. Thus, it is no wonder that the great majority of subjects opted for the second lottery, which the authors interpret as an evidence of risk perception according to the Dalton approach. We hold that it is just a reflection of the dominance relation. This behavior is all the more prevalent if the minimum

[14] Cf. Cowell and Schokkaert (2001) for a literature survey

payoff (as a proxy for risk) is doubled than when it is merely multiplied by 1.5. This explains the more than 70% agreement to opt for the second lottery in the first column of Amiel, Cowell, and Polovin's Table 1 (pp. 970-971). The rest of the subjects may easily be explained with unattentiveness given the lack of material incentives and comparable figures for the violation of the anonymity axiom in questionnaire studies of income distributions.

The most comprehensive joint analysis of risky prospects and income distributions so far seems to be Bernasconi's (2002) paper. Bernasconi investigated distributional axioms and their counterparts in risk analysis (e.g., the transfer principle and mean preserving contractions; Pareto dominance and first order stochastic dominance) under three framing modes, viz. framed as lotteries, framed as income distributions, and lottery preferences asked from impartial observers. He did not employ material incentives, but used income distributions and lotteries with up to four outcomes. Bernasconi tested the independence axiom, the betweennes axiom (randomization aversion, neutralitiy, or preference), the transfer principle/mean preserving contractions, and Pareto dominance/first order stochastic dominance. He did not observe dramatic systematic differences between the framing modes,[15] but found a joint rejection of Harsanyi's social welfare function with respect to the evaluation of income distributions, and expected utility for the evaluation of lotteries.

The present paper compares multi–valued income distributions and multi–valued lotteries following ten different distributions. Material incentives were applied both to motivate subjects to reveal their true preferences and to war-

[15]It seems that his rather heterogeneous subject groups impaired the quality of his data, as he did not control for systematic differences in his subjects' characteristics (students of a state university versus students of a private university with high fees.

rant that they make efforts at a proper understanding of the experimental design. This setting enabled us to investigate income happiness and lottery happiness of different distributional shapes, in particular whether negatively skewed distributions breed happiness as Parducci (1968) has argued. Moreover, we can also check interrelationships between the happiness with distributions and the pattern of dominating and intersecting Lorenz curves. Happiness was elicited in terms of two response modes, viz. rating scales and valuation (EDE and CE, respectively). This enabled us to examine whether a phenomenon akin to preference reversal exists also for rating and valuation of income distributions, and compare it with the empirical evidence of preference reversal of lotteries. Moreover, new insights can be gained about preference reversal of lotteries, for instance, do multi–outcome lotteries really reduce the extent of preference reversal [as Weber (1984) found], or is there a robust pattern of preference reversal which is not much different from the results of binary lotteries [as Casey (1991) observed], and whether preference reversal exists also for lottery pairs beyond positively and negatively skewed lotteries.

Of course, we are well aware that happiness is a multifarious phenomenon which is decisively shaped by perceptions of distributional equity.[16] Therefore, we adopted a simple experimental design and avoided any remarks (e.g., concerning work effort or talents) which might have triggered equity considerations which could not be controlled for. Also we carried out our experiments in terms of the local currency and concluded them well before the introduction of the EURO to avoid effects of money illusion and transitory effects of

[16]Cf. Miller (1995) for a good survey of empirical results. Subjects' perceptions are often blurred and inconsistent. Moreover, there are large differences in attitudes across nations.

yet insufficient acquaintance with and adaption to the new currency. For the sake of analytical comparability, however, we express all figures in terms of EURO.

2 The Experiment

The experimental design consisted of two experiments, one concerning income distributions, and one concerning lotteries. Each experiment encompassed two parts, a rating part, and a valuation part. Both experiments were administered at the ESSE laboratory at the University of Bari in Italy, as well as at the University of Castellon, Spain. 55 subjects participated in each of the two experiments in Bari, and 50 (income distributions) and 52 (lotteries) in Castellon. Subjects were only admitted to one experiment to avoid anchor effects. The order of presentation of income distributions and lotteries in Italy and in Spain was reversed to control for order effects. The data of one subject of the lottery experiment in Italy had to be discarded.[17]

The stimulus material consisted of ten distributions which are displayed in Figure 1. The distributions were, however, not presented in this form familiar to economists, but in the presentation format developed by Lopes (1984, 1987) and Schneider and Lopes (1986), as this seemed to be better comprehensible to subjects. Each distribution was an arrangement of 100 tally marks, and each distribution had the same expected value of about 1,800 EURO, save for rounding errors in order to secure decent numbers in terms of the local currency (Lire and Pesetas, respectively).[18]

[17] This subject rated every lottery with 10, telling the experimenter that this was his fortune number.

[18] Due to such influences the average level of entries in terms of EURO's were some 5% higher in Italy than in Spain.

Insert Figure 1 about here

Let us first focus on the experiment pertaining income distributions. At the beginning, subjects were asked to read carefully the instructions and the payment regulations. To make sure that subjects properly understood the experiment, they had then to pass an examination consisting of ten multiple–choice questions.[19] Subjects were informed that for each incorrectly answered question they had to face a 10% cut of their payoff; it they had only a record of five or less correct answers, they would be excluded from any payoff.[20]

Then subjects received a booklet with two times the ten distributions displayed in Figure 1 in terms of the local currencies. To test for order effects, the distributions were presented in the same order than in Figure 1 in Italy, and in the reverse order in Spain.[21] Subjects were told that the population consisted of 100 millions of income earners, and that each tally mark in a distribution represents exactly 1 million of income earners. The figures represented monthly incomes because subjects are more accustomed with monthly salaries in Italy and Spain. Subjects were solicited to imagine to have an equal chance to become one of the 100 millions of income earners in this society. Subjects were told that they would not know ex ante their precise income in this society. All they knew was the distribution of monthly incomes. They were then asked to state on a 20–point rating scale

[19] These are available from the authors upon request.

[20] Out of 55 subjects in Italy, only five scored at 6 or 7 correctly answered questions for both experiments; all others scored at least at eight correctly answered questions. In Spain, five out of 50 subjects scored at 7 for the distribution experiment, and 6 out of 52 scored at 7 for the lottery experiment; all other subjects scored better.

[21] We assumed only modest cultural effects between Italy and Spain, which allows to test order effects. Contrary to that we were able to show in Section 3 that order effects are absent, but some cultural effects exist for the comparison of income distributions only.

their degree of happiness to enter a society in which the respective income distribution obtained. The rating scale extended from 1 (very unhappy) to 20 (very happy).

Thereafter, subjects were asked to imagine that they could alternatively enter a society in which all income earners have the *same* monthly income. They were invited to indicate this level of income such that they were *indifferent* between the respective income distribution and the alternative in which each person receives the same income [EDE].

Subjects were arranged in groups of at most ten. They were informed that income distributions have to obtain for the group as a whole. Therefore, one participant of the group would be randomly chosen, and, for this particular person, two income distributions would then be randomly chosen. The higher rated income distribution would become the group's income distribution, and all subjects in this group would be assigned tokens according to this same income distributions. Thus, subjects had to resume responsibility for the income distribution of the whole group. A draw was made from this distribution for any subject in the group. This constituted the first part of tokens. The second part of tokens came from the statement of EDE, where tokens were gained by way of a Becker–DeGroot–Marschak [BDM] incentive scheme, whose working was carefully explained to subjects. A subject's total tokens was then made up as the sum of the two token parts. Payoffs were determined by dividing the total number of tokens by 500.

The lottery part of the experiment differed from the above design in minor points only. Subjects were told that each tally mark in the lotteries represented exactly one ticket equal in value to the amount listed in the respective line of the distribution of the lottery. Subjects had an equal chance to draw one of the 100 tickets of the respective lottery. Subjects were asked to state on a 20–point rating scale their degree of happiness to play the respective lottery, as well as their CE (as a selling price) which was elicited by way of the BDM incentive scheme.

In contrast to the income–distribution experiment, lotteries were *individually* chosen. For each subject, a pair of lotteries was drawn at random, and the higher ranked lottery was played out, whose result represented the first part of tokens. The second part came from the BDM incentive scheme applied to the elicitation of the CE for this lottery. Payoff was again determined by dividing the sum of tokens by 500.

3 Results

Recall that the transfer principle in the field of income distributions is equivalent to mean–preserving contractions in the field of lotteries. Every transfer satisfying the transfer principle shifts the Lorenz curve closer to the diagonal. Any mean–preserving contraction of lotteries, too, shifts the associate Lorenz curve of the respective lottery closer to the diagonal. Thus, inequality averse and risk averse subjects should prefer Lorenz curves closer to the diagonal; tho opposite should hold for inequality or risk loving subjects:[22] What about intersecting Lorenz curves? Suppose that the Lorenz curve of income distribution [lottery] x cuts the Lorenz curve of income distribution [lottery] y; suppose further that the income distributions [lotteries] have the same mean. Then subjects who want to avoid the expectation of relatively low incomes [payoffs] should prefer income distributions [lotteries] whose Lorenz curves lie near the diagonal at the low end, and subjects who are sympathetic to the expectation of relatively high incomes [payoffs] should prefer income distri-

[22] Lopes (1984), p.475.

butions [lotteries] whose Lorenz curves lie far from the diagonal at the high end.[23] Then, if the Lorenz curve of x intersects the Lorenz curve of y from below, x should be preferred to y by subjects who do not mind the expectation of relatively low incomes [payoffs] but are suspicious of the expectation of relatively high incomes [payoffs] because the former is associated with a low probability of low incomes [payoffs] and a high probability of satisfactory incomes [payoffs]. In other words, a situation with a few poor persons [low payoffs] and many persons with satisfactory incomes [satisfactory payoffs] is preferred to a situation with many persons with moderate incomes [payoffs]and few persons with rather high incomes [payoffs].

Figure 2 depicts the relationships of the Lorenz curves of our experimental design: An increasing arrow means that the Lorenz curve of the distribution [lottery] of the respective line cuts the Lorenz curve of the distribution [lottery] of the respective column from below. A horizontal arrow means that the Lorenz curve of the distribution [lottery] of the respective line dominates the Lorenz curve of the distribution [lottery] of the respective column. Intersections within 2% from below or from above were ignored.

Insert Figure 2 about here

When screening the data, we noticed that subjects made different use of the 20–point rating scale. Some settled more on the lower end, some on the upper end, and some dwelt on extremes. To avoid assigning different weights to subjects, we normalized the rating scales, assigning a 1 to the lowest ranked income distribution [lottery], and a 10 to the highest ranked income distribution [lottery].

Table 1 provides a summary statistic of the results. Notice that the mean ratings of the negatively skewed distributions [(1),(4),(5)] is higher than the

[23] Lopes (1987), p.270.

mean ratings of the positively skewed distributions [(2),(3),(9),(10)]. The same holds for the ratings of lotteries. Moreover, the spread of the ratings is higher in Spain than in Italy. Concerning the valuations the opposite holds, that is, the EDE's and the CE's are lower for the negatively skewed distributions than for the positively skewed distributions. This confers a smell of preference reversal at the aggregate level. It will be examined in greater detail later. Notice also that the mean EDE's are somewhat higher than the respective mean CE's. Of course, normalized ratings cannot display difference, yet nonnormalized ratings (not shown in Table 1) reveal hardly any difference between the mean rating of distributions (11.35) and the mean rating of lotteries (11.55). Between Italy and Spain, there are no big differences between the EDE's and between the CE's of these countries, in spite of the by 5% higher mean of the lotteries in Italy. Again we observe a preference reversal in the aggregate between the unimodal and the rectangular distributions: The unimodal distribution scores higher than the rectangular distribution in the mean ratings both for distributions and lotteries, but has lower EDE's and CE's than the rectangular distribution. An analogous preference reversal emerges for the rectangular and bimodal lotteries: The bimodal lottery has higher mean ratings but smaller mean CE's than the rectangular lottery. Another aggregate preference reversal occurs between the negatively skewed and the rectangular distributions both in terms of income distributions and lotteries. The preference reversal phenomenon seems to play thus a major role not only for multi–outcome lotteries, within and beyond generalized P–bet/$–bet pairs, but also for the realm of income distributions.

Insert Table 1 about here

Let us now again employ the mean normalized ratings and valuations to canvass conformity with the Lorenz relations of the experimental design as exposed in Figure 2. A summary statistic is provided in Table 2. What strikes us at first sight is the inverse mirror–image of the first two and the second two lines in Table 2. We have to check the structure of Figure 2 for Italy and Spain, which makes for 90 Lorenz relations. For the mean rating of distributions, 89% conform with the hypothesis displayed in Figure 2; for the mean rating of lotteries, the confirmations rate is still 70%. For the valuations, the conformity with the entries in Figure 2 switch to the opposite, viz. 83% and 89% of the Lorenz relations point in the opposite direction.

Insert Table 2 about here

This documents that subjects tend to a higher rating of distributions and lotteries whose Lorenz curves either dominate, or cut the Lorenz curves of other distributions from below, that is, the perception of happiness reacts more to restrictions on excessive incomes [payoffs] than to the presence of low income echelons [small payoffs].[24] This tendency is more pronounced for distributions than for lotteries.[25]

What are the exceptions to this rule? For the rating of both distributions and lotteries, (1), in spite of being Lorenz–dominated by (4) and (5), has a higher rating. Note that all three distributions are negatively skewed (and have, to repeat, identical means). The greater attractiveness of (1) seems to be caused by the higher maximum income [payoff] which is accorded to

[24]In terms of Temkin's (1986, 1993) theory, this results from the complaints of income recipients in lower income echelons. In an experimental investigation of the Temkin theory, Devooght (2002) found particular support for the weighted sum of the gaps of incomes in excess of mean income and mean income.

[25]Notice that the support of all income distributions avoided incomes below the poverty line. Incomes below the poverty line or even below the subsistence level would create a different dimension of perception and would, thus, have diverted subjects' attention from the evaluation of different distributional shapes.

31% of income recipients [holders of lottery tickets]. Our Italian subjects seem to dislike the bimodal distribution (8) and be in favor of the unimodal distribution (6), whereas our Spanish subjects exhibit appreciation of the rectangular distribution. For lotteries, subjects seem to shy at the lotteries with the highest standard deviations (8), (9), and (10).

In the evaluation experiments the common tendency is to accord lower values to Lorenz–dominating distributions [lotteries] and to distributions [lotteries] whose Lorenz curves cut the Lorenz curves of other distributions [lotteries] from below. Exceptions from this rule concern again (4,1) and (5,1) for distributions [for lotteries only for Italy], for which the higher maximum income for (1) did not overcompensate Lorenz dominance.[26] Moreover, the bimodal distribution (8) seems to have some attractiveness in terms of valuation, which was also noticed from Table 1. Similarly, the unimodal distribution (6) exhibit a higher mean EDE than distributions (2) and (3) [also (8) for Spain].

Let us now turn to a between–subjects analysis, which traces the dependence of ratings and valuations on parameters, and tests also for ordering and cultural effects. For this purpose we used data of both Italy and Spain to estimate the equation

$$\mathrm{D} = \mathrm{C} + \alpha\mathrm{SD} + \Delta_\alpha\mathrm{SD} + \beta\mathrm{SK} + \Delta_\beta\mathrm{SK} + \gamma\mathrm{KU} + \Delta_\gamma\mathrm{KU} + \varepsilon, \tag{3}$$

where D denotes the dependent variable [normalized rating or valuation] as a function of a constant C, the standard deviation SD, the skewness SK, and

[26]This result is contrary to the findings of Bohm, Lindén and Sonnegård (1997) who observed a bias of the BDM elicitation scheme to produce higher selling prices for a higher upper bound of payoffs. In our case, the higher maximum payoff of distribution [lottery] (1) vis–à–vis distributions [lotteries] (4) and (5) did not sufficiently increase the EDE of distribution (1) [CE of lottery (1), not for Spain] to exceed the EDE of distributions (4) and (5).

the kurtosis KU. The Δ's denote dummy variables, where Δ=0 denotes Italy and Δ=1 denotes Spain. ε is the usual error term.

First we tested for multicollinearity based of variance inflation factors, but found none. Then we applied the method of stepwise regression, successively eliminating coefficients until all remaining coefficients were significant at the 5% significance level. The estimates of the coefficients are presented in Table 3.

Insert Table 3 about here

Recall that we presented the stimulus material in the opposite order in Italy and Spain. With the exception of the rating of distributions, all dummy variables proved to be insignificant. This allows us to reject order effects as well as cultural effects, the latter ones save for the rating of distributions. We see that the rating of distributions is a decreasing function of the standard deviation.[27] This influence of the standard deviation is attenuated for Spain. Moreover, skewness matters for Spain. Negatively [positively] skewed distributions receive higher [lower] ratings. Negative skewness breeds higher happiness of income distributions in view of our Spanish subjects.

Lottery rating depends only on skewness: Negative [positive] skewness increases [decreases] lottery happiness. This provides a splendid evidence for Parducci's hypothesis that "happiness is a negatively skewed distribution". EDE, in contrast, is an increasing function of standard deviation, skewness, and kurtosis. It resembles the parameters of CE, which is an increasing function of standard deviation and kurtosis, however, not of skewness. Thus, standard deviation and skewness work in opposite directions for the rating

[27] The standard deviation may well be considered as a proxy for Temkin's aggregate complaints. Cf. also Devooght (2002).

and the evaluation exercises. They decrease rating, but increase valuation, which is another indicator of preference reversal.

Let us now turn to a within–subjects analysis. Our comprehensive experimental design allows us to track new patterns of preference reversal and other behavioral particularities. The traditional method to study preference reversal is to compare lottery preferences elicited by way of a choice between two lotteries with their CE's. However, this method would have outstayed our subjects' patience. To control for order effects, subjects would have had to make 10×9=90 choices. To control in addition for intransitivities, these 90 choices would have to be repeated several times. To avoid such intractable experimental design, we elicited subjects' preferences by the above–mentioned 20–point rating scale for income distributions and lotteries, which was normalized to its pure ordering on a 10–point rating scale.

Insert Tables 4–7 about here

Tables 4–7 contain the results of preference reversals. These tables are arranged that, when reading the lines, the income distribution [lottery] of the respective line has a higher rating than the distribution [lottery] of the respective column, and the EDE [CE] of the distribution [lottery] of the line is smaller than or equal to the EDE [CE] of the distribution [lottery] of the respective column. When reading the columns, the income distribution [lottery] of the respective column has a lower rating than the distribution [lottery] of the respective line, and the EDE [CE] of the distribution [lottery] of the respective column is greater than or equal to the EDE [CE] of the distribution [lottery] of the respective line. To illustrate, cell (1,8) in Table 4 tells us that 32 of 55 Italian subjects displayed a preference reversal in the sense that they rated distribution (1) higher than distribution (8), but assigned an EDE to distribution (1) which is smaller than or equal to the EDE assigned to distribution (8). Cell (8,1) in Table 4 tells us that exactly 1 out of 55 Italian subjects showed an inverse preference reversal between these two lotteries.

Recall that a negatively skewed distribution is a generalized P–bet, and a positively skewed distribution is a generalized $–bet. Then classical preference reversal would predict a high incidence in cells (1,2),(1,3),(1,9),(1,10), (4,2),(4,3),(4,9),(4,10),(5,2),(5,3),(5,9),(5,10). Classical inverse preference reversal would predict a low incidence in cells (2,1),(3,1),(9,1),(10,1),(2,4), (3,4),(9,4),(10,4),(2,5),(3,5),(9,5),(10,5). We see that this pattern holds for the income distributions [weakest for the inverse preference reversal in cells (2,5) and (3,5) in the Italian Table 4]. For lotteries, it is satisfied for Italy with the exception of lottery (10) being the second lottery of a preference reversal. For lotteries in Spain, it is largely satisfied for preference reversals, but not satisfied for inverse preference reversals when (9) or (10) are the first lotteries. Notice that lotteries (9) and (10) have the highest payoffs among all lotteries. This might have contributed to a tendency in the direction of inverse preference reversals, which was first observed by Casey (1991). There is indeed one Casey–case in Table 7, viz. the cells (1,10) and (10,1). Interestingly enough, this tendency is absent in the domain of income distributions. The incitement of high payoffs in lotteries, which caused high ratings, works in the opposite direction for distributions. Few excessive incomes within an income distribution depress the rating of the respective distributions.

However, in addition to the conventional preference reversals, Tables 4–7 show us a plethora of more preference reversals. All taken together, we observe 48% of distributional preference reversals out of a total of 2475 cases [45 comparisons of distributions times 55 subjects] in Italy and 51% in Spain.

Lottery preference reversals of any kind amount to 42.1% in Italy and 53.7% in Spain.

The borders of Tables 4–7 provide insight into the structure of preference reversals and inverse preference reversals. For all four tables we see that preference reversal is, in particular, prevalent for negatively skewed distributions and lotteries. They tend to higher ratings but lower EDE's or CE's than other lotteries. Moreover, negatively skewed distributions and lotteries exhibit a low incidence of adverse preference reversal. However, the unimodal distribution (6) is also prone to engender preference reversals and only few inverse preference reversals.

A pattern which varies for income distributions and lotteries emerges for distributions and lotteries (2) and (3). These are positively skewed distributions with a high floor, both in terms of incomes [payoffs] and probabilities. This prompts subjects to rate them higher in their capacity of income distributions, but lower as lotteries, so that preference reversals exceed inverse preference reversals for income distributions, whereas inverse preference reversals are higher for (2) and (3) for lotteries. Subjects seem to keep an eye on floor constraints for the rating task in the domain of incomes. In contrast to that, they keep an eye on high payoffs for the rating task in the lottery domain. A similar dichotomy emerges for the bimodal distribution (8). Its rating is rather low for income distributions because subjects are weary of extreme distributions (many rich and many poor people with not many in between), but higher in terms of lotteries. Positively skewed distributions with conventional floor constraints, such as (9) and (10), show low ratings but high EDE's, which determines them to high rates of inverse preference reversal, which is attenuated for lotteries for the Spanish subjects. The rectangular distribution tends to low ratings in Italy, which the Spanish subjects shared with respect to lotteries, but not for income distributions.

These results demonstrate severe response–mode effects of the evaluation of income distributions and lotteries. EDE's and CE's are, therefore, no reliable tools for unambiguous assessment of the value which a subject attributes to an income distribution or a lottery. This means that ethical or Kolm–Atkinson–Sen–type inequality measures lack an empirical bedrock.

Another objection against these inequality measures is their empirical violation of the transfer principle. Ethical inequality measures (let them be denoted by I) are theoretically required to satisfy

$$0 \leqslant I = 1 - \frac{\text{EDE}}{\mu} \leqslant 1. \tag{4}$$

This can hold if and only if $0 < \text{EDE} \leqslant \mu$, where μ denotes mean income. $\text{EDE} > \mu$ implies violation of the transfer principle, the sacred cow of inequality measurement. As the mean income [expected value] of our income distributions [lotteries] is slightly above 1,800 EURO's, Table 1 shows us that $\text{EDE} \leqslant \mu$ is violated in the aggregate for all but the negatively skewed income distributions. On average, subjects respect the transfer principle only for negatively skewed distributions; they violate it for all other distributions. Notice, in contrast to that, that mean CE's exceed μ only for the positively skewed and the rectangular distributions. When restricting our inspection to the EDE and CE parameters only, we would end up with the finding that, on average, subjects are more risk averse than inequality averse. However, the mean ratings invalidate this one–sided conjecture, a phenomenon which is due to the ubiquity of preference reversals.

Thus, a comparison of EDE and CE with μ to make inferences on inequality [risk] aversion or sympathy, does not make sense. Recall that Tables 4–7 represent only an odd half of all cases. The other half is made up of consistent behavior in accordance with relation (1).

Therefore, we tried to make use of the (μ, σ)–principle and, as all μ's are identical, order the income distributions and lotteries according to increasing standard deviation σ, and arrange them in tables akin to Tables 4–7. The lines of these tables mean that the rating and the EDE [CE] of the distribution [lottery] of the respective line are higher than the rating and the EDE [CE] of the distribution [lottery] of the respective column. The columns of these tables mean that the rating and the EDE [CE] of the distribution [lottery] of the respective column is smaller than the rating and the EDE [CE] of the distribution [lotery] of the respective line. If small line sums and high column sums of distributions [lotteries] coincide with high standard deviations, this evidences inequality [risk] aversion. Alas, this pattern emerges only for the domain of income distributions, and, among these, only for the distributions (8), (9), and (10). No other message can be gathered from these tables; therefore, we omitted them from this paper.

4 Conclusion

Although there is a close relationship between income distributions and risky prospects, their joint analysis is much in its infancy. Moreover, multi–outcome distributions and lotteries have never been employed systematically, material incentives were never used,preference reversal was never tested for income distributions (although the EDE has become the central hub of ethical inequality measures), and the influence of the distributional shapes on the evaluation of distributions and their perception of happiness has not been systematically investigated.

The experimental design encompasses ten distributions (three negatively skewed, four positively skewed, one rectangular, one unimodal, and one bimodal), which were used as stimuli for an income–distribution and a lottery experiment, which were administered to more than 50 subjects each both in Bari and Castellon. Subjects' comprehension of the experimental setting was examined before the experiment proper and material payoffs were applied. Subjects were asked to rate the income distributions [lotteries] and were solicited to supply their EDE's [CE's] using a BED incentive scheme.

The experimental data evidenced the following results:

1. The mean ratings of the negatively skewed income distributions and lotteries exceed the mean ratings of the positively skewed income distributions and lotteries. This pattern is reversed for EDE's and CE's. Similar phenomena were also observed for the other distributions.

2. The mean EDE's are somewhat higher than the mean CE's. The mean (nonnormalized) ratings of income distributions and lotteries are about equal.

3. The mean ratings of the income distributions reflect Lorenz dominance and assign higher ratings to income distributions whose Lorenz curve cuts the Lorenz curve of other income distributions from below, that is, the presence of high income is perceived to disturb happiness more than the presence of low incomes. The opposite pattern is observed for lotteries.

4. Order effects can be ruled out. Cultural effects esist only for the rating of income distributions.

5. The rating of income distributions is a decreasing function of standard deviation. Its influence is attenuated for Spain. For Spain, the rating of distributions is a decreasing function of skewness. Lottery rating is a

decreasing function of skewness, thus validating the Parducci hypothesis. EDE is an increasing function of standard deviation, skewness, and kurtosis. CE is an increasing function of standard deviation and kurtosis.

6. Preference reversal is abundant both for income distributions and for lotteries. About one half of all cases exhibit preference reversal. In addition to classical preference reversal and classical inverse preference reversal we observe quite generally preference reversal for negatively skewed distributions and for the unimodal distribution. Positively skewed distributions tend to inverse preference reversals.

7. The condition that mean EDE is not greater than μ is violated for all but the negatively skewed income distributions. This implied a robust violation of the transfer principle.

8. Because of the high incidence of preference reversal, perception of income distributions is plagued by severe response–mode effects. This invalidates ethical inequality measures if peoples' imaginations of distributional equity are taken the measuring rod.

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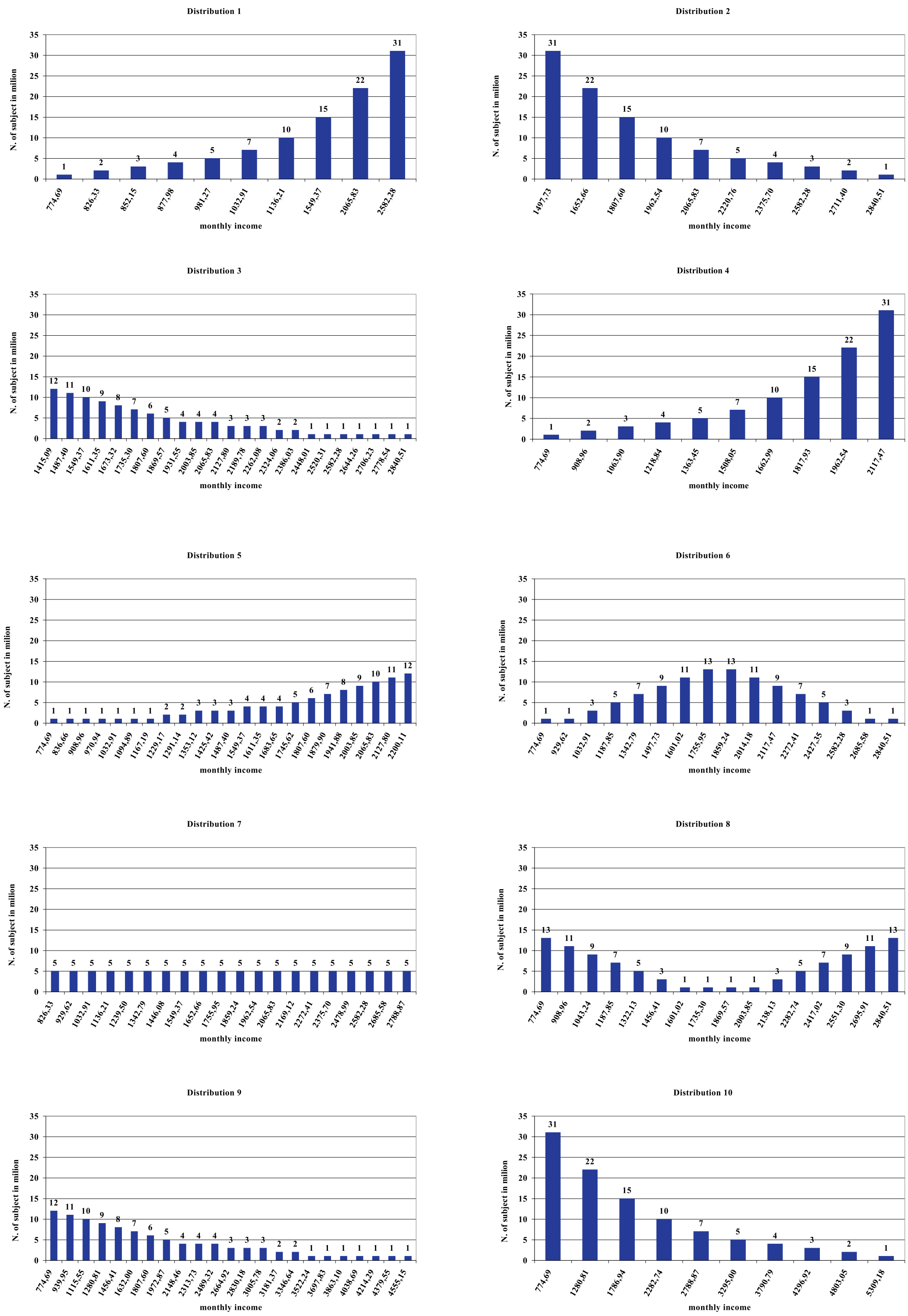

Figure 1: Distributions of the experimental design

	1	2	3	4	5	6	7	8	9	10
1		$\nearrow$	$\nearrow$			$\nearrow$	$\nearrow$	$\rightarrow$	$\rightarrow$	$\rightarrow$
2			$\rightarrow$				$\rightarrow$	$\rightarrow$	$\rightarrow$	$\rightarrow$
3							$\rightarrow$	$\rightarrow$	$\rightarrow$	$\rightarrow$
4	$\rightarrow$	$\nearrow$	$\nearrow$		$\rightarrow$	$\nearrow$	$\rightarrow$	$\rightarrow$	$\rightarrow$	$\rightarrow$
5	$\rightarrow$	$\nearrow$	$\nearrow$			$\nearrow$	$\rightarrow$	$\rightarrow$	$\rightarrow$	$\rightarrow$
6		$\nearrow$	$\nearrow$				$\rightarrow$	$\rightarrow$	$\rightarrow$	$\rightarrow$
7								$\rightarrow$	$\rightarrow$	$\rightarrow$
8									$\underset{\sim}{\nearrow}$	$\rightarrow$
9										$\underset{\sim}{\rightarrow}$
10										

$\nearrow$ ... Lorenz curve of the distribution of the respective line intersects the Lorenz curve of the distribution of the respective column from below.

$\rightarrow$ ... Lorenz curve of the distribution of the respective line dominates the Lorenz curve of the distribution of the respective column.

$\sim$ ... both Lorenz curves nearly coincide for the lowest 13%.

Nota bene: Intersections of Lorenz curves up to 2% taken from the bottom or the top of the domain were ignored.

Figure 2: Lorenz Relations of Stimulus Distributions

Shape of Distributions	Mean Normalized Rating				Mean Valuation in €			
	Distribution		Lotteries		Distribution (EDE)		Lotteries (CE)	
	Italy	Spain	Italy	Spain	Italy	Spain	Italy	Spain
Negatively Skewed	6.63	7.25	6.83	7.00	1675.42	1742.22	1628.65	1706.59
Positively Skewed	4.77	4.19	4.81	4.66	1970.62	1974.22	1886.05	1909.74
Unimodal	6.64	6.26	5.57	4.90	1857.37	1842.63	1735.91	1767.14
Rectangular	4.22	5.97	4.35	4.02	1998.44	1931.13	1835.15	1821.07
Bimodal	3.11	4.20	4.91	4.94	1895.48	1827.18	1748.97	1788.84

Table 1: Mean Normalized Ratings and Valuations

	No. of Cells in Conformity with Fig.1	No. of Cells Opposite to Fig.1	Remarks
Mean Rating of Income Distributions	80	10	Nonconformity for both: (4, 1), (5, 1) Nonconformity for Italy: (4, 6), (5, 6), (8, 9), (8, 10) Nonconformity for Spain: (2, 7), (3, 7)
Mean Rating of Lotteries	63	27	Nonconformity for both: (4, 1), (5, 1), (3,8), (3, 9), (3,10), (7, 8), (7, 9), (2, 10), (7, 10), (8, 10), (9, 10) Nonconformity for Italy: (3, 7) Nonconformity for Spain: (2, 8), (2, 9), (6, 8), (6, 10)
Mean EDE's	15	75	Conformity for both: (2, 3), (4, 1), (5, 1), (6, 2), (6, 3), (7, 8) Conformity for Spain: (2, 8), (6,8), (5, 2)
Mean CE's	10	80	Conformity for both: (2, 8), (7, 8) Conformity for Italy: (4, 1), (5, 1), (3, 8) Conformity for Spain: (1, 3), (2, 3), (6, 3)

Table 2: Conformity of Behavior with Lorenz Relations

	Constant	SD	△ SD	SK	△ SK	KU
Rating Distributions	7.65717*	−0.000416	0.00081*	–	−0.90456*	–
Rating Lotteries	5.58017*	–	–	−0.80978*	–	–
EDE (in €)	1647.28*	0.37821*	–	42.69372**	–	54.08177*
CE (in €)	1562.14*	0.42803*	–	–	–	54.47724*

n (distributions) = 1050, n (lotteries) = 1060, *significant at the 1% level,

**significant at the 5% level.

Table 3: Coefficient Estimates of the Parameters of Distributions and Lotteries

Distribution	1	2	3	4	5	6	7	8	9	10	$\sum$	%
1		15	18	26	26	18	28	32	26	29	218	18.3
2	8		12	8	10	9	14	15	20	21	117	9.8
3	7	18		6	11	9	17	19	20	23	130	10.9
4	10	18	15		15	13	23	26	21	24	165	13.9
5	6	14	16	10		10	21	27	20	25	149	12.5
6	8	17	16	8	14		15	21	22	22	143	12.0
7	0	6	7	4	8	6		9	12	13	65	5.5
8	1	6	6	7	6	4	13		12	14	69	5.8
9	4	8	6	4	4	5	11	14		7	63	5.3
10	2	10	7	5	4	6	11	13	12		70	5.9
$\sum$	46	112	103	78	98	80	153	176	165	178	1189	100.0
%	3.9	9.4	8.7	6.6	8.2	6.7	12.9	14.8	13.9	15.0	100.0	48.0

$n = 2475$

Table 4: Preference Reversals for Distributions (Italy)

Distribution	1	2	3	4	5	6	7	8	9	10	$\sum$	%
1		18	22	7	15	20	19	24	25	27	177	15.4
2	8		11	6	6	9	8	11	21	25	105	9.2
3	8	13		7	8	6	10	10	23	26	111	9.7
4	13	20	19		21	15	16	22	28	27	181	15.8
5	9	16	14	10		17	17	15	28	29	155	13.5
6	7	12	9	8	11		14	14	23	28	126	11.0
7	2	10	10	6	11	9		12	19	24	103	9.0
8	7	11	10	3	5	7	12		20	18	93	8.1
9	5	9	12	5	6	4	5	7		14	67	5.8
10	3	3	5	2	2	2	1	3	12		29	2.5
$\sum$	62	112	112	54	85	89	102	118	195	218	1147	100.0
%	5.4	9.8	9.8	4.7	7.4	7.8	8.9	10.3	17.0	19.0	100.0	51.0

$n = 2250$

Table 5: Preference Reversals for Distributions (Spain)

Distribution	1	2	3	4	5	6	7	8	9	10	$\sum$	%
1		21	19	20	19	22	24	22	22	16	185	18.1
2	3		9	8	4	6	11	6	13	11	71	6.9
3	2	12		5	3	5	8	3	9	9	56	5.5
4	6	16	21		13	13	18	20	20	14	141	13.6
5	4	15	22	8		11	23	13	19	14	129	12.6
6	0	16	23	4	8		15	12	19	13	110	10.7
7	2	11	13	4	5	10		6	14	9	74	7.2
8	6	12	17	6	7	10	21		16	12	107	10.4
9	3	13	14	5	8	8	15	9		11	86	8.4
10	2	11	11	5	6	5	7	6	12		65	6.3
$\sum$	28	127	149	65	73	90	142	97	144	109	1024	100.0
%	2.7	12.4	14.6	6.3	7.1	8.8	13.9	9.5	14.1	10.6	100.0	42.1

$n = 2430$

Table 6: Preference Reversals for Lotteries (Italy)

Distribution	1	2	3	4	5	6	7	8	9	10	$\sum$	%
1		25	26	17	22	23	23	25	15	14	190	15.1
2	10		20	7	9	8	13	9	15	10	101	8.0
3	7	4		5	6	8	14	10	15	5	74	5.9
4	10	15	20		17	19	21	18	18	17	155	12.3
5	8	18	21	10		23	22	20	19	16	157	12.5
6	7	14	19	11	11		17	13	18	17	127	10.1
7	10	9	17	8	8	12		14	15	13	106	8.4
8	5	14	15	5	9	12	16		10	14	100	8.0
9	10	13	18	10	11	11	17	13		7	110	8.8
10	15	17	16	14	15	12	17	16	15		137	10.9
$\sum$	82	129	172	87	108	128	160	138	140	113	1257	100.0
%	6.5	10.3	13.7	6.9	8.6	10.2	12.7	11.0	11.1	9.0	100.0	53.7

$n = 2340$

Table 7: Preference Reversals for Lotteries (Spain)