PERCEPTIONS OF INEQUALITY
AND RISK

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ABSTRACT
This paper analyses the principles underlying the theories of risk and inequality, and the connections between the two. Using two experimental designs, we investigate the structure of individuals’ rankings of uncertain prospects in terms of risk and inequality. We examine these individual perceptions in the light of the conventional principles underlying risk and inequality. We show that, although the principle of mean-preserving spreads and the principle of transfers are often rejected a weaker principle, “lowest-to-highest” is usually supported.

Keywords: Inequality; Risk; Experiment; Transfer principle; Mean-preserving spread

JEL classification: C13; D63

1. INTRODUCTION
This paper brings together economic theory and experimental methods to study some of the key questions at the heart of inequality analysis and its intellectual cousin, the analysis of risk. Conventional approaches to these two concepts often focus on the strength of inequality or risk aversion from the point of view of theoretical interconnections (Cowell & Gardiner, 2000), experimental investigations

Studies on Economic Well-Being: Essays in the Honor of John P. Formby
Research on Economic Inequality, Volume 12, 99–132
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ISSN: 1049-2585 doi:10.1016/S1049-2585(04)12004-8
(Kroll & Davidovitz, 2003) or the estimation of preferences from questionnaire responses on risk (Barsky et al., 1997) and on inequality (Amiel et al., 1999).

Such approaches take for granted an analytical framework that imposes an a priori structure on distributional comparisons including inequality indices and measures of risk. Our aim is to assess the validity of some of the key assumptions of this analytical framework in an investigation of the structure of individuals' rankings of income distributions and rankings of uncertain prospects in terms of risk and inequality.

We first provide a brief outline of the theory of risk and inequality, establishing the connection points between the two and highlighting the central assumptions that are common to both fields and that are used to formulate a system of distributional rankings. These core assumptions provide the focus for our experimental enquiry – we want to know (i) whether they accord well with the way in which people make distributional comparisons and (ii) whether there are differences between the role played by essentially the same assumption in the two different types of distributional comparison. We then describe the methodology and results of two different experimental settings designed to deal with each of these points.

The methodology employed for this paper involves the use of questionnaire-experiments. While the use of experiments in economics has progressed rapidly in recent decades in the study of markets and individual interactions, similar work on normative economics and the study of preferences is still comparatively rare. The literature described in Amiel and Cowell (1999) developed an original experimental setting for studying the empirical validity of inequality measurement axioms, and we extend it to analyse individual perceptions of risk.

The basic intuition behind these experiments is that the agents' personal judgments may not be captured adequately by conventional theory. The benchmarks against which the axioms are compared are the perceptions and judgements from responses to carefully specified questionnaires.

Our first experiment, derived from previous studies of inequality perceptions, focuses mainly upon whether responses conform to standard axioms of inequality analysis and its relation with risk theory. We extend the approach with a new experiment that covers the main assumptions of risk theory, in order to provide a comparison between the two.

Finally, we introduce the Virtual Laboratory, a novel web-based experimental tool for the study of normative issues and preferences in economics. This tool supersedes previous studies which were based on paper questionnaires.

The paper is organised as follows. Section 2 starts with a brief discussion of the theoretical background in terms of basic principles and previous research on the issue. Section 3 contains a description of the experimental setup, reviews
the content of the experiments, and illustrates the advantages of the novel
Internet-based experimental tool employed for the experiments. Finally, in
Section 4 we present some results from the questionnaires we administered to a
set of students. Conclusions follow.

2. THEORETICAL BACKGROUND

In recent years experimental methods in economics have been extended to the
analysis of income distributions (Amiel & Cowell, 1999). The main purpose
of this literature is to establish whether conventional approaches to modelling
inequality, welfare and related concepts are consistent with the way individuals
view income distributions. This paper extends this research by studying the
analogies and differences between the theories and perceptions of inequality and
risk. There thus are two central questions at the heart of the present paper. The first
question refers to how the concepts of inequality and risk are related, both in terms
of theory and in terms of individual perceptions. Second, we also wish to establish
if people’s comparisons of inequality and risk deviate systematically from the
orthodox theoretical structure of distributional and risk comparisons. We provide
below a brief outline of the two theories that will guide the empirical discussion.

2.1. Inequality and Risk

The literature on distributional rankings in the context of uncertainty and risk is an
important basis for the modern inequality literature (Atkinson, 1970; Rothschild
& Stiglitz, 1970, 1971, 1973). In addition to the obvious similarity of measures of
spread (risk or inequality) in the two disciplines, there are three further issues for
consideration.

The first one relates to the analogy on which much of the distributive analysis is
based. One can argue that the analysis of probability distributions is an appropriate
basis for the analysis of income distributions. The similarity of structure of the
two problems lies at the core of a number of key contributions in the literature on
distributional analysis (Nermuth, 1993).

A second issue refers to the connection to a normative criterion which is present
in both the inequality and the risk literature. In the case of inequality there is
the “reduced form” or “abbreviated” social welfare function (Champernowne &
Cowell, 1998; Lambert, 2002)

\[ W = \phi(I, \mu) \]
where $W$ is social welfare, $I$ is inequality and $\mu$ is mean income; Eq. (1) may be used to map an inequality ordering into a welfare ordering, or to obtain inequality rankings from welfare rankings using the inverse relationship $\phi^{-1}$ from (1). Likewise, in the context of ranking probability distributions

$$u = \phi(R, \mu)$$

connects utility (individual preference) $u$ to a measure of risk $R$ and expected payoff $\mu$. From the inverse of (1) inequality is inherited from the particular system of values represented by $W$; and from the inverse of (2) the risk concept is inherited from the preferences represented by $u$.

Finally, a third issue is that risk orderings can be considered an essential ethical foundation for the axiomatisation of inequality comparisons, since social values on income distribution can (or should) be derived from the private values that guide individual choices in the face of uncertainty. This relies on the familiar argument of a representative individual making social choices behind a “veil of ignorance” as to identity: when asked to rank income distributions, a representative, involved person behind the veil of ignorance, would rank them according to a set of values $u$. These values for the individual then become the social values $W$ (Harsanyi, 1953, 1955; Rawls, 1971). Given this equivalence of $W$ and $u$, there is, by extension, an equivalence of the “inherited” concepts $I$ and $R$.

### 2.2. Distributional Comparisons

How should one compare distributions? In the inequality literature it is common practice to adopt either a direct axiomatisation of inequality itself or an indirect axiomatic approach through a social-welfare relationship such as the inverse of Eq. (1). Typically, this axiomatisation is consistent with Lorenz ranking of distributions. In the case of risk the consensus approach defines risk in the context of individuals’ preferences under uncertainty. However, there is a good case for claiming that the leading model of preferences under uncertainty – the Expected Utility (EU) representation – does not adequately capture rankings of uncertain prospects. Because the notion of risk itself is the by-product of the specific axiomatisation of the preference structure from which it was extracted, risk-rankings derived from EU are not necessarily general and may be inappropriate. Even if peoples’ preferences violate the assumptions of EU, this does not mean that they have incoherent perceptions of risk. For instance:

- People may not think in terms of preferences over prospects in formulating risk judgments.
Perceptions of Inequality and Risk

Even if they do have well-defined preference orderings over prospects, their attitudes to risk may not be well represented by an EU utility model. EU is restrictive in that it imposes an additive separability on the utility function that implies strong assumptions about the way individuals perceive choices among alternative prospects. For this reason a number of alternative models – such as rank-dependent expected utility, for instance – have been considered as different representations of individual preferences under uncertainty. People may not be risk-averse in the sense of disliking mean-preserving spreads.

What is the way forward? A conventional argument suggests the use of the standard stochastic dominance approach (Hadar & Russell, 1969). If the second-order dominance criterion is applied to a set of income distributions with the same mean then one can derive the Lorenz order for risk as in the case of inequality. However, the adoption of the stochastic dominance approach encounters two difficulties in the present case:

1. Stochastic dominance is not about the nature of risk per se but about the structure of preferences under uncertainty; a similar point can be made in the case of inequality.

2. It is sometimes persuasively argued that rooting inequality analysis (the ranking by $I$ in Eq. (2)) in social welfare (the ranking by $W$ in Eq. (1)) relies on assumptions that are too strong: in order to characterise inequality, it is not necessary to assume first the conditions required for a Bergson-Samuelson SWF to exist. A more parsimonious axiomatic structure can be adopted. The same position could be argued for basing risk comparisons (rankings by $R$) on personal preferences under uncertainty (rankings by $u$): risk can be axiomatised simply and directly without first modelling utility.

If the purpose of comparing distributions is to make some statement about risk then it is appropriate to axiomatise risk directly. Of course the preference structure implied by this axiomatisation could then be derived from a relationship of the form (2). The parallel case could be made for approaching inequality directly rather than via social welfare.

There is another strong argument for the direct approach in the case of risk. The approach using individual preferences under uncertainty is appropriate for events that directly affect the individual (an agent that has well-defined preferences over the distribution of events that affect his or her income) but it is not clear that they are appropriate for uncertain events in which the individual has no personal stake. (What do the agent’s preferences in the face of uncertainty have to do with the evaluation of the distribution of events that affect another agent’s income?) However, it is reasonable to imagine that one can have a coherent method for evaluating risk...
comparisons that are consistent for situations where there is personal involvement
and for those where there is no involvement (the agent’s evaluation of the
riskiness of an income prospect is the same whether it involves his/her income or
someone else’s).

Accordingly we now focus on the direct approach to the axiomatisation of
inequality (risk).

2.3. Axioms

The core axioms that are taken as standard in the literature in the inequality
(risk) fields are: (1) anonymity, (2) the transfer principle (MPS principle of
mean-preserving spreads), (3) the population principle (normalisation), (4) group
decomposability (independence axiom), and (5) scale independence.3

These axioms and their interpretation are well-known,4 and several of them
(1, 2 and 4 in the list, for instance) have direct counterparts in the corresponding
 axiomatisation of preferences or welfare. The third item in the list merits further
mention here. The transfer principle (Dalton, 1920) and its risk counterpart, the
principle of mean-preserving spreads (MPS) (Rothschild & Stiglitz, 1970) are of
special interest because they are central to almost all of the modern literature in
the two fields.

Definition 1 (MPS principle). Let \( x_i \) and \( x_j \) be any two income payoffs asso-
ciated with events labelled \( i \) and \( j \) such that \( x_j > x_i \); if ceteris paribus a small
amount of income is transferred from \( i \) to \( j \) risk must rise.

Definition 2 (Transfer principle). Let \( x_i \) and \( x_j \) be the income of any two persons
\( i \) and \( j \) such that \( x_j > x_i \); if ceteris paribus a small amount of income is transferred
from \( i \) to \( j \) inequality must rise.

Notice that both definitions focus on the concept of a (dis)equalising pure income
transfer: if in a given distribution there is a disequalising transfer between outcomes
(Definition 1) or persons (Definition 2) then according to these principles risk
or inequality respectively must rise. The transfer principle is powerful in that
it is the basis of the Lorenz curve and of all stochastic dominance criteria of
the second-order and higher (Fishburn & Willig, 1984; Kolm, 1969; Marshall &
Olkin, 1979). But it may be too powerful, because it rules out the consideration
of information about income distributions that might be used by people in making
comparisons involving inequality or risk. A weaker version of same idea may be
more appropriate for in the sense of better reflecting the agent’s minimum common
view about this type of orderings.

**Definition 3** (“Lowest-to-Highest” (LTH) principle). If ceteris paribus a small
amount of income is transferred from the person with the lowest income to the
person with the highest income inequality must rise.

It should be stressed that neither the transfer principle nor the LTH principle say
anything about re-rankings in the income distribution that do not affect both the
donor and recipient of the notional transfer.

### 2.4. The Approach
These theoretical issues have driven the research on inequality and risk perceptions.
We wish to extend previous studies by:

1. Contrasting risk-rankings and distributional rankings over uncertain prospects
   expressed in terms of individual preference.
2. Comparing the results on risk through the two experimental contexts, one
   based on inequality in a society and the other based on uncertain individual
   prospects.

A comprehensive study that tackled just item 1 and tried to disentangle the
concept of risk *per se* from the language of preference would require the investi-
gation of several key axioms twice over – for the functions $U$ and $R$ defined above.
This would clearly be demanding. We will provide some evidence with respect to
(1), but in a more narrowly-focused manner. We will assess the effect of (1) and
(2) on risk and distributional comparisons involving the key assumptions of the
MPS principle (in risk or preference interpretation) and its principle-of-transfers
counterpart. Specifically we want to investigate:

- Whether individuals regularly assess specific pairwise distributional compar-
  isons using the MPS principle (risk) or the principle of transfers (inequality) –
  **Definitions 1 and 2**.
- Whether there is broad agreement with either the narrowly focused
  MPS/principle of transfers or with the LTH principle – **Definition 3**.

As auxiliary questions, we will try to establish whether the personal involvement
in risky prospects makes any difference with respect to their evaluation. Finally, we
will also study try to identify individual characteristics that may be systematically
correlated with the way agents make risk and income distribution rankings.
We pursue this by means of a series of experiments described in the following section.

3. EXPERIMENTAL SETTING

3.1. The Inequality and Risk Experiment: Rationale and Implementation

Eliciting preferences or attitudes from economic data is not an easy task, as some of the studies trying to obtain revealed preferences from economic aggregates have found. The questions set out in the previous section are intrinsically related to the study of individual’s perceptions of risk and inequality. Our methodology relies on questionnaire-experiments specifically designed to tackle these problems, continuing the research programme described in Amiel and Cowell (1999). The outcomes of the experiments represent levels of agreement and disagreement with the main axiomatic structures which are being tested.5

The questionnaire-experiments aim to establish the type of judgements about a certain concept (inequality, risk, welfare, etc.) implicitly made by the experimental subjects when comparing distributions of potential outcomes.

We will present findings from two related experiments. The first one, the “Paper – Inequality and Risk” (PIR hereafter) was administered in the form of paper questionnaire, and focuses on the similarities between perceptions of risk and inequality (see Amiel & Cowell, 1999, 2002 for a lengthy discussion of their administration and previous results). The second experiment, “Virtual Laboratory – Risk and Preference” (VRP from now on) shares many of the PIR characteristics, but it concentrates on orderings in terms of riskiness and preference. The VRP study was designed and implemented through the Virtual Laboratory, a novel Internet-based tool for the administration of questionnaire experiments (see below for a more detailed description). The Appendix contains copies of both questionnaires.

In the PIR experiment (a variation of the original experiments on inequality perceptions; Amiel & Cowell, 2002), the respondents were presented with a fictional underlying story with respect to policy options in some non-existent country. The fact that there were no correct answers was stressed to encourage pure statement of preferences. They were then presented with pairs of vectors representing alternative income distributions, and were asked to rank them in terms of some specific criteria (more/less unequal, or more/less risky). After six of these “numerical” questions, aimed at the implicit assumptions behind the subject’s choices, the following section presented a “verbal” question which enunciated different versions of the principle on which the questionnaire was focusing, the MPS. This choice allows the researcher to capture in a more explicit
way the perception underlying the subject’s comparisons between distributions in
the “numerical” questions, albeit in a more restrictive format.

The key feature of these questionnaire-experiments is the existence of at least
two versions of each questionnaire, with random assignment of respondents to
each category. This information was only known by the researchers, and respon-
dents were (implicitly) induced to think that they were all answering the same
questions. Ideally, one would like to ask the same person similar questions in terms
of riskiness and inequality, to test whether any of the two formulations makes any
difference with respect to the agent’s perceptions and judgements. This is clearly
not possible, since asking the same or very similar questions would bias the
respondent’s answers. Randomisation, then, seems to be the answer to this issue.

All versions of the questionnaires share the same structure, the same vectors
representing income distributions and closely related verbal questions, but are
phrased in fundamentally different ways: in the PIR case, respondents either
classified the distributions as more or less unequal, or as more or less risky,
according to which category they were randomly assigned to.

The PIR experiments exploited the analogies between risk and inequality.
Using the methodology developed for the inequality field, we will present next
an attempt to deal with the question – what is the meaning of risk comparisons?

3.2. The Risk and Preference Experiment

The VRP experiment shares the structure of the PIR and previous questionnaire-
experiments, but shifts the focus from inequality to risk. As discussed in the
theoretical section, a specific model of preference – expected utility – is usually
taken as the vehicle for the microeconomics of choice in the face of uncertainty.
However, there are alternative possibilities – potentially “appropriate” axiom struc-
tures – for representing risk comparisons. The new experiment presented in this
section aims to distinguish fundamentally different patterns of risk comparisons.

The VRP experiment, our setting for the study of risk, draws from the original
design of the inequality studies, with a series of innovations.

In previous experiments, such as the PIR, judgements about inequality
necessarily involved taking into account the society as a whole, and so the ques-
tionnaires were designed in terms of fictional countries in an attempt to produce
an “Olympian” detachment of the respondents. In the case of risk, however, we
considered that the individual’s perceptions required him or her to be involved.
Given that our respondents were students, we decided to ask our questions in
terms of potential jobs. The numerical vectors would not represent the distribution
of income in a society, but the earning possibilities of two different jobs. However,
should the hypothetical situation refer to him/herself, or to someone close? To analyse the effect of the level of involvement, we also study the issue of whether individuals would recommend the same prospects for themselves or for a friend.\textsuperscript{6}

The experiment follows the structure of previous studies (Section 3.1), consisting of six numerical questions and one verbal question. In order to compare both experimental results, we adopted for the VRP numerical questions the same income vectors as in the PIR experiment (and the same as in Amiel & Cowell, 2002). In this case, instead of focusing on the principle of transfers, we are studying the agreement with the closely related idea of individual risk-rankings with respect to the MPS principle. For each pair of vectors, the first can be obtained from the second by a mean preserving spread, and thus the agreement of the respondent with the MPS principle can be easily deduced.

Dealing with the other two points raised (whether rankings by risk are simply the reverse of ranking by preference over distributions with a given mean, and whether risk-rankings are independent of personal involvement by the individual), however, is not self-evident. We thus adopted the randomisation procedure described in the previous section and in Amiel and Cowell (2002). While we could not ask similar questions to the same respondent, we could still assign different types of questionnaires at random. With a sufficiently large and carefully selected sample, we can test whether different questionnaire formats matter for answers to questions with the same underlying structure. We are thus able to examine the structure of both types of comparison (risk/preference rankings, and personal involvement) simultaneously.

There is a randomisation between the risk and preference types of questionnaire, and also with respect to the way in which the questions are phrased: respondents are asked to choose a job for themselves, or alternatively which option they would recommend to a friend. The two randomisations result in four types of questionnaires, from a combination of the two sets of categories defined as follows:\textsuperscript{7}

\begin{itemize}
  \item **Risk/Preference:** in the numerical questions, the options are labeled “More/less risky” (risk) or “Better/worse” (preference).
  \item **Friend/Self:** the questionnaires ask about a prospective job offer to be considered by the respondent (self), or for advising a friend (friend).
\end{itemize}

Thus the four questionnaire types only differ in the introduction, in the wording of the numerical questions and in the corresponding differences in wording of the verbal question.

Finally, the VRP experiment introduces a major innovation in the experimental setup, which we briefly discuss next.
3.3. Beyond Paper Based Questionnaires:  
The Virtual Laboratory Approach

Another innovation in the VRP experiment is the design and administration of experiments through the Virtual Laboratory. The PIR and previous experiments were conducted through paper questionnaires in the classroom (see for instance Amiel, 1999; Amiel & Cowell, 1999). For the VRP study, we developed an extension of the original methodology that supersedes the paper based questionnaire-experiments.

At the core of the research is a new Internet-based technology, the Virtual Laboratory, a facility for designing and running questionnaire experiments. The motivation of the Virtual Laboratory is three-fold: (a) individual respondents can participate remotely; (b) interaction with the Web-server is designed in a way that allows observation of the process of reaching decisions as well as final judgments; and (c) researchers at remote locations can develop and redesign experiments and download results automatically.

After logging on to the questionnaire site, the respondent is presented with a general preamble, followed by an explanation about the format of the numerical questions. The preamble stresses the fact that there are no right or wrong answers, and that the researchers are interested solely in the respondent’s judgements and preferences. The six following windows correspond to the numerical questions. A brief text then explains the background to the verbal questions, which consists of a set of pre-defined multiple choice answers and a box for the user to complete. Finally, there are two sets of questions about the respondent’s background and characteristics, followed by a page thanking the respondent for his/her participation in the experiment. An online demonstration of the risk experiment accessible through the World Wide Web.

We now turn the nature of our sample and present our results.

4. DATA AND RESULTS

4.1. Samples and Questionnaires

The VRP experiment was administered to a sample of ninety-two London School of Economics students during the academic years 2001/2002 and 2002/2003. The students were mostly undergraduates from Economics and other social disciplines. Students received an email from a teacher or a lecturer inviting them to follow a link and participate in a brief internet questionnaire. We set up a random draw of 25 GBP as a way to motivate the student’s participation in the experiment. While
Table 1. Characteristics of VRP Respondents.

<table>
<thead>
<tr>
<th>Characteristics Variable</th>
<th>Obs.</th>
<th>Mean</th>
<th>S.D.</th>
<th>Min.</th>
<th>Max.</th>
<th>PV Risk</th>
<th>PV Fr.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>87</td>
<td>20.24</td>
<td>2.12</td>
<td>18</td>
<td>31</td>
<td>0.329</td>
<td>0.372</td>
</tr>
<tr>
<td>Female</td>
<td>92</td>
<td>42%</td>
<td>0.50</td>
<td>0</td>
<td>1</td>
<td>0.571</td>
<td>0.422</td>
</tr>
<tr>
<td>Employed before</td>
<td>92</td>
<td>41%</td>
<td>0.50</td>
<td>0</td>
<td>1</td>
<td>0.913</td>
<td>0.971</td>
</tr>
<tr>
<td>Family inc. (1–7)</td>
<td>85</td>
<td>4.5</td>
<td>1.12</td>
<td>2</td>
<td>7</td>
<td>0.173</td>
<td>0.780</td>
</tr>
<tr>
<td>Inc. prospect (1–7)</td>
<td>84</td>
<td>5.2</td>
<td>0.92</td>
<td>2</td>
<td>7</td>
<td>0.433</td>
<td>0.515</td>
</tr>
<tr>
<td>Subject = Econ.</td>
<td>92</td>
<td>63%</td>
<td>0.49</td>
<td>0</td>
<td>1</td>
<td>0.867</td>
<td>0.719</td>
</tr>
<tr>
<td>Pol. Views (1–7)</td>
<td>85</td>
<td>4.1</td>
<td>0.95</td>
<td>2</td>
<td>6</td>
<td>0.447</td>
<td>0.317</td>
</tr>
<tr>
<td>Left</td>
<td>92</td>
<td>21%</td>
<td>0.41</td>
<td>0</td>
<td>1</td>
<td>0.372</td>
<td>0.372</td>
</tr>
<tr>
<td>Right</td>
<td>92</td>
<td>30%</td>
<td>0.46</td>
<td>0</td>
<td>1</td>
<td>0.447</td>
<td>0.317</td>
</tr>
<tr>
<td>Preference-Self (PS)</td>
<td>25</td>
<td>27.2%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Preference-Friend (PF)</td>
<td>17</td>
<td>18.5%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Risk-Self (RS)</td>
<td>20</td>
<td>21.7%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Risk-Friend (RF)</td>
<td>30</td>
<td>32.6%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

It might be argued that this lottery would attract students with biased preferences over risky prospects, the results outlined below are roughly consistent with previous findings obtained in non-remunerated experiments and questionnaires. Table 1 contains summary statistics of the respondents’ characteristics collected at the end of the questionnaire. As can be expected from a group consisting mainly of undergraduate students, the average age is only 20.2 years, with 82% of respondents between 18 and 21 years old. The sample contains a majority of males (58%), which reflects the composition of the courses in which the experiments were administered. A relatively high 41% of the students declared themselves to have been employed before coming to university. Regarding the subject of study, 63% of the respondents follow an economics degree (or a mixed economics degree – i.e. ”Economics and Finance,” etc.). In terms of political views, respondents were asked to classify themselves in a one to seven scale, where four represented the centre, lower values the left and higher values the right. The mean of this variable, 4.1, suggests that the sample is relatively balanced with respect to political views.

Finally, for a set of reasons (privacy, the international nature of the sample, avoiding missing answers from indiscreet questions), students were not asked about their current incomes, but instead were required to classify their family incomes in 1990 and their expected future income in 2010 in a one to seven scale (one being poor and seven rich). We can see that our group of respondents are relatively optimistic about the future, with a mean of past family income of 4.5 and future income of 5.2.
As explained in Section 3.2, the VRP experiment consists of four different types of questionnaires from the mix of friend/self and risk/preference categories. In order to make inferences about the relevance of these categories for the experiment’s answers, we must verify that there was no bias in the assignment of the respondents.

Reassuringly, the evidence confirms that the sample is well balanced among categories. The questionnaires were assigned randomly to the students by a computer handled randomisation which worked correctly. While we can observe in the bottom panel of Table 1 that there are relatively more risk-friend and less preference-friend questionnaires, this is mostly due to the small size of the sample (simulations with the Virtual Laboratory show that increasing the number of questionnaires would result in a convergence of 25% for each category). Most importantly, Table 1 contains the p-values of t-tests of differences in means in respondent characteristics between the risk and preference and the friend and self questionnaires. None of these differences are even barely significant at the standard levels, confirming that the allocation of questionnaires was truly random.

The PIR (inequality and risk) samples and results have been described in Amiel and Cowell (2002), and we only use it as a comparison group for the VRP study. We will thus only cover it briefly. During 1998/1999, the PIR questionnaire experiment was carried out on twelve samples of undergraduate students from seven countries. The questionnaire was conducted during regular class or lecture time; two roughly equal-sized sets of questionnaires (one for inequality, one for risk) were distributed to the students. Each student received just one questionnaire and completed it under the supervision of the class teacher or lecturer in about 10 or 15 minutes. The questionnaires consisted of three parts corresponding to the three phases of the Internet questionnaire. As with the VRP study, the student respondents provided information about basic personal characteristics, which are roughly comparable between the two studies. The combined sample consisted of 1153 responses, randomly assigned with equal probability to inequality (587) and risk (566).

4.2. Basic Results

4.2.1. VRP’s Numerical Questions and the MPS Principle

As explained above, in the numerical questions the respondents were asked to choose between two vectors of possible outcomes. The two options A and B for each of the six numerical questions are depicted in Table 8 in Appendix A. In the VRP study, each vector represented the distribution of potential wages for two jobs.
Table 2. VRP Numerical Questions by Type of Questionnaire.

<table>
<thead>
<tr>
<th>Questions</th>
<th>Answers</th>
<th>Friend</th>
<th>Self</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Risk</td>
<td>A</td>
<td>106 (63.1%)</td>
<td>70 (58.8%)</td>
<td>176 (61.3%)</td>
</tr>
<tr>
<td></td>
<td>AB</td>
<td>44 (26.2%)</td>
<td>37 (31.1%)</td>
<td>81 (28.2%)</td>
</tr>
<tr>
<td></td>
<td>B</td>
<td>18 (10.7%)</td>
<td>12 (10.1%)</td>
<td>30 (10.5%)</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>168 (100%)</td>
<td>119 (100%)</td>
<td>287 (100%)</td>
</tr>
<tr>
<td>Preference</td>
<td>A</td>
<td>32 (31.7%)</td>
<td>24 (17.8%)</td>
<td>56 (23.7%)</td>
</tr>
<tr>
<td></td>
<td>AB</td>
<td>19 (18.8%)</td>
<td>29 (21.5%)</td>
<td>48 (20.3%)</td>
</tr>
<tr>
<td></td>
<td>B</td>
<td>50 (49.5%)</td>
<td>82 (60.7%)</td>
<td>132 (55.9%)</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>101 (100%)</td>
<td>135 (100%)</td>
<td>236 (100%)</td>
</tr>
</tbody>
</table>

A and B, while in the PIR study A and B represented the possible distributions of income in a fictional country. It should be stressed that in all numerical questions the vector represented by A was obtained from B by a mean-preserving spread (see Section 3.2).

Table 2 presents the VRP results for the total number of questions answered (523) from the groups of 90 respondents with complete characteristics. Given the pattern the construction of options A and B, in the risk questionnaire the choice of option A (“A more risky”) corresponds to the agreement with the MPS principle, while in the preference questionnaire this “orthodox” view was reflected by the choice of option B (“B better”). We will present the answers in terms of options A, B and AB (indifference) in this first table, but for the rest of the document we will re-code the answers and deal with categories defined as agreement/indifference/disagreement with the MPS principle.

From this table we can extract some preliminary conclusions. While agreement with the MPS principle is high, it seems to be higher for the risk questionnaire (61.3% vs. 55.9% of the answers). Given the sample size, the t-tests of this difference are not significant at the 5% level (not reported), the differences in the indifference and rejection rates of the MPS are large (28.2% vs. 20.3%, and 10.5% vs. 23.7%, for risk and preference respectively). The disagreement with the MPS principle is thus substantially higher when the question is phrased in terms of preference. The differences in answers between the self and friend versions are small and not significant at standard levels.

The previous table presented the results when considering each individual’s six numerical answers. When aggregating by individual, “full agreement” with the MPS principle requires a simple but strict pattern of responses: “AAAAAA”
Table 3. VRP Numerical Questions, Aggregated.

<table>
<thead>
<tr>
<th>Questionnaire</th>
<th>PS</th>
<th>PF</th>
<th>RS</th>
<th>RF</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Disagr. w/MPS (%)</td>
<td>13</td>
<td>33</td>
<td>–</td>
<td>8</td>
<td>12</td>
</tr>
<tr>
<td>Indifference (%)</td>
<td>17</td>
<td>7</td>
<td>30</td>
<td>23</td>
<td>20</td>
</tr>
<tr>
<td>Agreement w/MPS (%)</td>
<td>70</td>
<td>60</td>
<td>70</td>
<td>69</td>
<td>68</td>
</tr>
<tr>
<td>Total (%)</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>N</td>
<td>23</td>
<td>15</td>
<td>20</td>
<td>26</td>
<td>84</td>
</tr>
</tbody>
</table>

in the case of risk, and “BBBBBB” in the case of preference. The subsample adopting this “pure” form of response is sparse: preference-self: 5 respondents, preference-friend: 1 respondent, risk-self: 3 respondents and risk-friend: 9 respondents. Because of this sparseness, in the following tables we have aggregated each respondent’s six answers in the three categories mentioned above (agreement/indifference to/disagreement with the MPS). We assigned an individual to one of these groups only if 50% or more of the six answers corresponded with A or B, or to a third residual category.

The results of this aggregation are presented in Table 3, broken down by the four types of questionnaires. In the VRP experiment, around 68% of the respondents agree with the MPS principle. However, a non-negligible 32% does not accept it (weakly and/or strongly). The preference-friend type has the highest strong rejection rate (33%), with no “disagreement” with the MPS principle in the risk-self case. This is important because this case is perhaps the most standard way of presenting the question. Of course, this is due to the reclassification of the results that amalgamate the answers to six questions into one category: in Table 2, we can observe that there were as many as 30 answers (from a total of 523) rejecting the MPS principle in the risk-self category.

Finally, the case of strong rejection of the MPS principle is much more important for questions asked in terms of preference (21%) than risk (4%) (Table 3), confirming the findings of Table 2. Breaking down answers by self or friend questionnaires, there is a much higher probability of a strong rejection of the MPS if the questionnaire was of the friend type (17%) than the self (7%).

4.2.2. PIR Numerical Questions and the MPS/Transfer Principle

Table 4 presents the results from the PIR experiment, which indicate that about 60% of the responses view an equalising transfer as inequality/risk reducing. However, no more than about one fifth of the students ticked response A for all six questions, a choice reflecting the transfer principle, and equivalent to the case of “full agreement” with the MPS principle mentioned above.
Table 4. PIR Numerical Questions by Type of Questionnaire.

<table>
<thead>
<tr>
<th></th>
<th>Risk</th>
<th>Inequality</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>2368 (61.2%)</td>
<td>2389 (59.7%)</td>
<td>4757 (60.4%)</td>
</tr>
<tr>
<td>AB</td>
<td>899 (23.2%)</td>
<td>914 (22.8%)</td>
<td>1813 (23.1%)</td>
</tr>
<tr>
<td>B</td>
<td>602 (15.6%)</td>
<td>698 (17.5%)</td>
<td>1300 (16.5%)</td>
</tr>
<tr>
<td>Total</td>
<td>3869 (100%)</td>
<td>4001 (100%)</td>
<td>7870 (100%)</td>
</tr>
</tbody>
</table>

Breaking down these results by type of questionnaire, consistency with the MPS principle in the case of risk was higher (23%) than consistency with the principle of transfers in the case of inequality (17%). Finally, the result for the risk version of the RIP questionnaire is not at odds with the risk variations of the VRP questionnaire, as seen in Table 2.

4.2.3. Numerical Responses: Comparison of Approaches

When we compare the two types of study on a question-by-question basis an interesting pattern emerges. Table 5 shows that on every formulation of the experiment – risk, preference, inequality – the lowest support for the orthodox answer is the case of question 1 followed closely by question 6; the greatest support is for question 5 (VRP) or question 2 (PIR).

This is interesting because 5 and 2 involve only the extremes of the distributions (see Appendices A and B). In other words, where the transfer does not involve the highest income or the lowest income it is quite common to find responses that violate the transfer principle/MPS principle. Overall the responses seem to be consistent with the LTH principle – this is in line with the results surveyed in Amiel and Cowell (1999).

The simple analysis of the numerical questions shows, overall, a similar pattern of acceptance and rejection of the main theoretical principles of risk and

Table 5. Proportion of Conventional Responses by Question.

<table>
<thead>
<tr>
<th>Q1</th>
<th>Preference (%)</th>
<th>Risk (%)</th>
<th>Inequality (%)</th>
<th>Risk (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q1</td>
<td>33</td>
<td>45</td>
<td>40</td>
<td>49</td>
</tr>
<tr>
<td>Q2</td>
<td>54</td>
<td>70</td>
<td>74</td>
<td>68</td>
</tr>
<tr>
<td>Q3</td>
<td>56</td>
<td>66</td>
<td>61</td>
<td>59</td>
</tr>
<tr>
<td>Q4</td>
<td>59</td>
<td>76</td>
<td>60</td>
<td>68</td>
</tr>
<tr>
<td>Q5</td>
<td>78</td>
<td>84</td>
<td>72</td>
<td>67</td>
</tr>
<tr>
<td>Q6</td>
<td>55</td>
<td>58</td>
<td>48</td>
<td>55</td>
</tr>
</tbody>
</table>
inequality theory. This is important because the contexts of the experiments (and of the categories within the experiments) are different, even if the underlying numerical vectors are the same. We will now present a more elaborate version of these basic results, based on multivariate regressions.

4.3. Multivariate Analysis of Numerical Questions

The simple results of the previous section provide some indication of whether the type of questionnaire faced remains an important determinant of heterodox responses. The multivariate analysis presented in this section allows us to determine the significance of this effect conditional on the personal characteristics of the respondents. While respondents have been randomly assigned to the different categories in the PIR and VRP experiments, we are also interested in knowing if any of these characteristics have a systematic effect on the type of answers. To address this issue we use a standard probit regression of the form:

\[
\text{Pr(\text{Response Pattern})} = \Phi(b_1 y_1 + b_2 y_2 + \cdots + b_n y_n)
\] (3)

where \(y_j\) is a measure of personal or background characteristic \(j\), \((b_1, \ldots, b_n)\) is a vector of coefficients and \(\Phi\) is the normal distribution function. Let \(P\) denote the relevant probability on the left-hand side of (3). Then, given the probit model, it is clear that for the \(i\)th explanatory variable, the marginal impact of an increase in \(y_i\) on the probability is proportional to the coefficient \(b_i\) thus:

\[
\frac{dP}{dy_i} = b_i \varphi \left( \sum_j b_j y_j \right),
\]

where \(\varphi(\cdot)\) is the normal density function.

Given that there were \(m\) separate numerical questions (where \(m = 6\) in our case), we interpret the “Response Pattern” in (3) as the \(m\) separate responses (each of which could be A or B or indifferent). This gives us in principle \(mN\) observations, but since we have only \(N\) respondents, we will cluster the standard errors by individual to acknowledge the fact that observations from the same person are not independent. Not doing so would most likely introduce a spurious downward bias in the coefficient’s standard errors.

The dependent variable is equal to one if the respondent chose the “heterodox” option in the numerical question (among the options A, B or indifferent), and is set to zero otherwise. In the PIR experiment and in the risk version of the VRP, heterodoxy is represented by the choice of option B, while option A is unconventional for the preference version of the VRP experiment.
Table 6. Probit Results, Heterodoxy in Numerical Questions.

<table>
<thead>
<tr>
<th></th>
<th>VRP Experiment</th>
<th>PIR Experiment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Risk</td>
<td>$-0.1445 \text{ (} -3.80 \text{)}^{***}$</td>
<td>$-0.0241 \text{ (} -1.25 \text{)}$</td>
</tr>
<tr>
<td>Self</td>
<td>$-0.0598 \text{ (} -1.63 \text{)}$</td>
<td>$-0.0241 \text{ (} -1.25 \text{)}^{**}$</td>
</tr>
<tr>
<td>Age</td>
<td>$-0.0283 \text{ (} -2.25 \text{)}^{**}$</td>
<td>$0.0041 \text{ (} 1.67 \text{)}^{**}$</td>
</tr>
<tr>
<td>Male</td>
<td>$-0.0656 \text{ (} -1.65 \text{)}^{*}$</td>
<td>$-0.0841 \text{ (} -4.19 \text{)}^{***}$</td>
</tr>
<tr>
<td>Employed</td>
<td>$0.0700 \text{ (} 1.77 \text{)}^{*}$</td>
<td>$-0.0086 \text{ (} -0.40 \text{)}$</td>
</tr>
<tr>
<td>Left</td>
<td>$-0.0158 \text{ (} -0.30 \text{)}$</td>
<td>$0.0022 \text{ (} 0.09 \text{)}$</td>
</tr>
<tr>
<td>Right</td>
<td>$0.0065 \text{ (} 0.17 \text{)}$</td>
<td>$-0.0075 \text{ (} -0.32 \text{)}$</td>
</tr>
<tr>
<td>Economics</td>
<td>$0.0402 \text{ (} 1.13 \text{)}$</td>
<td>$-0.0786 \text{ (} -3.91 \text{)}^{***}$</td>
</tr>
<tr>
<td>Question 2</td>
<td>$-0.0836 \text{ (} -2.15 \text{)}^{**}$</td>
<td>$-0.2479 \text{ (} -14.68 \text{)}^{***}$</td>
</tr>
<tr>
<td>Question 3</td>
<td>$-0.0278 \text{ (} -0.84 \text{)}$</td>
<td>$-0.1528 \text{ (} -9.18 \text{)}^{***}$</td>
</tr>
<tr>
<td>Question 4</td>
<td>$0.0194 \text{ (} 0.46 \text{)}$</td>
<td>$-0.1793 \text{ (} -10.31 \text{)}^{***}$</td>
</tr>
<tr>
<td>Question 5</td>
<td>$-0.1187 \text{ (} -2.67 \text{)}^{***}$</td>
<td>$-0.2307 \text{ (} -11.96 \text{)}^{***}$</td>
</tr>
<tr>
<td>Question 6</td>
<td>$-0.0398 \text{ (} -1.02 \text{)}$</td>
<td>$-0.0645 \text{ (} -4.08 \text{)}^{***}$</td>
</tr>
<tr>
<td>Pseudo $R^2$</td>
<td>0.14</td>
<td>0.04</td>
</tr>
<tr>
<td>Observations</td>
<td>517</td>
<td>6306</td>
</tr>
</tbody>
</table>

Notes: Robust $z$ statistic in brackets, clustered by respondent. Except for age, $dF/dx$ is for the discrete change of a dummy from 0 to 1.

*Level of significance: 10%.
**Level of significance: 5%.
***Level of significance: 1%.

The left-hand side of Table 6 displays the results of the estimation for the VRP experiment, and the right-hand side exhibits the results for the PIR sample. These regressions also includes controls for each of the six numerical questions, since they imply different mean preserving spreads and thus we can expect respondents to evaluate them differently.

The results concerning the type of questionnaire clarify some of the points raised in previous sections. Answering a VRP questionnaire phrased in terms of risk has a very strong negative and significant effect on the probability of giving an heterodox answer: the estimated difference with respect to a preference questionnaire is of around 14.5 percentage points, different from zero at the 1% level. On the other hand, there also appears to be a negative effect on heterodoxy from answering a questionnaire involving the respondent instead of a friend, but this effect is only marginally significant at the 10.3% level.

Regarding the individual characteristics, a few of the explanatory variables included in the VRP study seem to have an effect. In line with most of the results of the inequality perceptions literature, being male has a negative effect on heterodoxy. The difference between men and women is estimated at 6.6 percentage points and is different from zero at the 10% level. Being older and
being employed also have a negative and significant effect on the probability of disagreeing with standard economic theory. These factors may be proxying for the small subset of postgraduate students in our sample who have been more exposed to the standard axioms of economic theory (found to be relevant in previous studies – Amiel & Cowell, 1999), although the indicator of being an economics student has no significant effect. Finally, there is no effect (with respect to the centre) of being at the right or at the left of the political spectrum.

The right-hand side of Table 6 summarises the corresponding results from PIR, which differ in the spirit of those described in Amiel and Cowell (2002). These authors carried out a separate analysis for their inequality and risk subsamples, while our research strategy is based instead in the random assignment of the respondents to each group and the similarity of the underlying questions. Instead of running two different regressions, we pool the samples to study the effect of the questionnaire type as an independent variable.

While the analysis of the VRP results showed strong differences attributable to the type of questionnaire, in our PIR regressions we cannot reject the hypothesis that the probability of giving a non-orthodox answer is not affected by the type of questionnaire, as witnessed by the low $z$ statistic of the risk questionnaire indicator. As far as this experiment is concerned, the perception of the income distribution from an inequality or riskiness point of view seems to be the same.

With respect to the personal characteristics of the respondents, there are four main features to point out.

• As in the VRP case and in most of the previous literature, male respondents view more often an equalising transfer as inequality or risk-reducing. In the PIR study, the male indicator has a stronger (8.4 percentage points) and more robust effect than in the VRP study: it is significant at the 1% level.

• The effect of age in the PIR regressions is positive, contrary to the findings of the VRP study. While significant, the effect – per year – is very small (0.4 percentage points of difference in the probability of an heterodox answer).

• A striking difference with respect to the VRP regressions, however, is that there is a negative (7.9 percentage points) and strongly significant (1% level) effect of being a student of economics, which is consistent with previous studies on inequality perceptions (Amiel & Cowell 1992). While it did not appear to have an effect in the VRP experiment, PIR respondents studying economics make distributional comparisons that are more in line with economic orthodoxy.

• The effect of type of question (which was discussed in a univariate context in Section 4.2.3) with respect to question 1, the excluded category, is qualitatively similar along the two studies, confirming that even with the major differences in the contexts, we can still compare studies based in risk an inequality. With
the exception of question 4 (negative and significant for PIR, not significant for VRP), the coefficients on the other question indicators are all negative: in terms of transfers or mean preserving spreads, the effects go in the same direction. It should be noted, however, that the absolute values of coefficients are much higher in the PIR context, with a maximum reduction in the probability of heterodoxy of 24.8 percentage points, compared with a maximum of only 11.9 percentage points in the VRP case. The heterodoxy of the answer seems to be much more volatile with respect to the transfers when talking about the society as a whole (income distribution in the PIR study) than when referring to individual outcomes (self’s or friend’s prospective wages in the VRP experiment).

We now turn to the analysis of the level of agreement and disagreement with the standard theory by focusing on the verbal section of the VRP and PIR studies.

4.4. The Verbal Question

The verbal question followed the same structure in the VRP and PIR experiments (see Appendix for details). In the VRP study, respondents were asked about the effect of a change in the income prospects of a job when a high paid position is lowered and simultaneously a low paid position is increased. In the PIR experiment, the question was phrased in terms of a transfer of income from a rich individual to a poor individual.

Respondents faced a set of statements and justifications about how risk, inequality, etc. would change after the transfer, and were invited to choose the one that corresponds to their views. There were five possible responses, including “none of the above,” and multiple selections were allowed. The choice of these responses was designed to cover the views corresponding to the MPS principle (VRP) and the transfer principle (PIR). Only option “D” is fully consistent with the standard risk/inequality theory view, while option “B” was written to reflect the LTH principle.

The fact that respondents were allowed to make multiple selections from question 7 means that we can interpret consistency with economic orthodoxy in either a broad or narrow sense. On the narrow interpretation people should have checked “D” and nothing else. However, it might be reasonable to look at cases where, because of difficulties with understanding the question, or some perceived ambiguity, respondents checked both “D” and one or more other possibilities.

We can see in Table 7 that for the VRP experiment 19% chose the orthodox answer, and less than 22% chose this option or this option combined with some other. These numbers were higher in the case of risk and friend questionnaires,
Perceptions of Inequality and Risk

Table 7. Verbal Question.

<table>
<thead>
<tr>
<th>Answer</th>
<th>VRP Freq. (%)</th>
<th>PIR Freq. (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>11.5</td>
<td>8.7</td>
</tr>
<tr>
<td>A and B</td>
<td>2.3</td>
<td>2.1</td>
</tr>
<tr>
<td>A and C</td>
<td>3.5</td>
<td>1.2</td>
</tr>
<tr>
<td>B</td>
<td>28.7</td>
<td>29.3</td>
</tr>
<tr>
<td>B and C</td>
<td>2.3</td>
<td>3.8</td>
</tr>
<tr>
<td>C</td>
<td>16.1</td>
<td>17.6</td>
</tr>
<tr>
<td>D</td>
<td>18.4</td>
<td>23.6</td>
</tr>
<tr>
<td>D and A</td>
<td>1.2</td>
<td>0.8</td>
</tr>
<tr>
<td>D and B</td>
<td>–</td>
<td>2.5</td>
</tr>
<tr>
<td>D and C</td>
<td>2.3</td>
<td>0.6</td>
</tr>
<tr>
<td>E</td>
<td>13.8</td>
<td>8.7</td>
</tr>
<tr>
<td>Other</td>
<td>–</td>
<td>1.3</td>
</tr>
<tr>
<td>Total</td>
<td>100</td>
<td>100</td>
</tr>
</tbody>
</table>

but only marginally so (not reported). Support for the pure MPS seems to be very low when spelled out directly.

Compare this with the results on the verbal question in the PIR study: 23% selected the pure orthodox answer in the inequality version and 24% in the case of risk (23.6% in total); 28% selected the orthodox answer possibly combined with something else for both versions of the PIR questionnaire. It seems that support for an explicit version of the orthodox economic answer was rather low, and lowest in the case of questions involving an individual risk/preference setup.

On the other hand support for the LTH was stronger: 28.7% selected answer “B” alone in the VRP experiment and 29.3% in the PIR, and 33.3% (VRP)/37.7% (PIR) selected “B” alone or in combination with something else. Since the LTH principle subsumes both “B” and “D,” we can interpret this evidence as support for this principle from about half of the VRP respondents and two-thirds of the PIR respondents.

5. CONCLUSIONS

Previous experiments have demonstrated that people often reject the transfer principle. The present experimental design allows us to say rather more on this issue.

In our risk-focused experiment (VRP), broad agreement with the MPS principle appears relatively high at more than 50% of the sample; but only a handful of the respondents chose options that were fully consistent with this principle; and even on any interpretation the level of disagreement is nonetheless non-negligible. With
respect to perceptions in terms of risk and preference, agreement with the MPS is higher for the risk version of the questionnaire. From the multivariate analysis it is clear that responding to a risk type of questionnaire implied a very strong negative and significant effect on the probability of giving an answer incompatible with the MPS principle. There also appears to be a mild negative effect from answering a questionnaire involving the respondent instead of a friend. Finally, males tended to provide responses more in line with orthodox theory.

The basic results from the inequality-focused experiment (PIR) are consistent with this pattern. The inequality study used a context that referred to a broader issue involving society as a whole and not isolated individuals. About 60% of the responses viewed an equalising transfer as inequality/risk reducing, and consistency with the MPS principle in the risk version of the questionnaire was higher than consistency with the principle of transfers in the inequality version. However, the regression results indicate that with respect to the MPS/transfer principles, phrasing the questions in terms of inequality rather than risk had no differential effect with respect to the ranking of distributions.

As in our risk experiment, in the inequality study male respondents viewed more often an equalising transfer as inequality or risk-reducing, with a similar effect from studying economics. PIR respondents who studied economics made distributional and risk comparisons that are more in line with economic orthodoxy.

When spelled out explicitly in the verbal question – instead of being inferred from choices on the numerical questions – support for the most orthodox version (MPS/transfer principles) was much lower at around 20%, as indicated by our “verbal” questions. However, support for a weaker version – the LTH principle – was substantially higher.

NOTES

1. For a review of experimental evidence on the EU model and other paradigms of individual decision making see Camerer (1995).
2. Kahneman and Tversky (1979) and Kahneman et al. (1982) are perhaps the most famous, but certainly not the only theoretical developments of non-EU theories.
3. Sometimes translation independence is invoked instead of scale independence.
4. In the case of inequality see, for example, Cowell (2000).
5. Gaertner and Jungeilges (1999) and Schokkaert and Devooght (1998) are examples of these experimental techniques applied to normative issues.
6. We owe this variation of the experiment to a suggestion by Yoram Amiel.
7. The four versions are also available online: http://darp.lse.ac.uk/types.htm.
8. It can be accessed by following the link: http://darp.lse.ac.uk/test/0302b/start.asp.

Note that since this is the same version administered to our respondents, the resulting
questionnaire will be one of the four versions described above, chosen at random by
the server. To see each of the four different versions, please use the following link:
http://darp.lse.ac.uk/types.htm.

9. To see each of the four different versions, please use the following link: http://
darp.lse.ac.uk/types.htm.

10. Alternatively, there is also an electronic version of the original PIR experiment,
equivalent to the VRP’s Virtual Laboratory implementation. It can be found at
http://darp.lse.ac.uk/experimentdemo.htm.

ACKNOWLEDGMENTS

This research was partially supported by the Centre of Analysis of Risk and
Regulation, LSE. G. Cruces acknowledges financial support from STICERD. The
paper has benefited from the comments of seminar participants at STICERD
(LSE), RID (Paris) and the University of Alabama.

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APPENDIX A: THE VRP QUESTIONNAIRES

As explained in the body of the paper, the VRP experiment was carried out using the Internet through the Virtual Laboratory. We will then provide the content of the questions for the four different versions. Readers should refer to the experiment’s website for the exact layout and “look and feel” of the experiment. The questionnaires were organised in thirteen web browser’s windows with the heading “Risk Questionnaire,” and so we will present their content by window number.

The first window (or page) respondents saw was a preamble that explained the purpose of the experiment, stressing the fact that there were no right answers and that the experiment was not a test. This general introduction, however, did not conceal information about the randomization process or the existence of four different questionnaires:

Window number 1 – Preamble

This questionnaire concerns people’s attitude to the risk associated with income prospects. We would be interested in your view, based on hypothetical situations. Because it is about attitudes there are no “right” answers. Some of the possible answers correspond to assumptions consciously made by economists: but these assumptions may not be good ones. Your responses will help to shed some light on this, and we would like to thank you for your participation.

The questionnaire is in three parts. Parts 1 and 2 each consist of a brief background “story” and then some questions. The third part is a request for some information about yourself. The whole questionnaire will probably take you about 10 to 15 minutes to complete.

The questionnaire is anonymous.

We will now provide the text specific to each of the four versions of the questionnaires – the numeric questions and the verbal question, with their

| Table A.1. VRP – Potential Wages Distributions, Numerical Questions. |
|----------------|----------------|----------------|
| Question      | Option A       | Option B       |
| Window 3 (1)  | [2592020]      | [2682030]      |
| Window 4 (2)  | [2592030]      | [3592029]      |
| Window 5 (3)  | [2592030]      | [2692029]      |
| Window 6 (4)  | [2592030]      | [21091530]     |
| Window 7 (5)  | [1010101030]   | [1010102020]   |
| Window 8 (6)  | [2592030]      | [2691930]      |
respective introductions. Finally, we will present the questions about individual characteristics which are common to all versions. Note that the numerical questions in all versions refer to the same vectors (Table A.1).

A.1 Risk-self Version

Window number 2 – Background to Part 1

You are advising a friend who has to make a choice between two job offers A and B. The monetary payoff to either job offer is not known with certainty. In job A or job B your friend could, with equal probability, be assigned to any one of five different positions with known incomes. Apart from the income prospects you and your friend believe the jobs to be equally attractive.

In each of the following six questions two alternative lists of incomes A and B (in the same currency) are given. Each of these pairs represents the outcomes of the A-job and the B-job in terms of the monetary rewards in each of the five possible positions. In each case please state which job-offer you consider would present the better prospects for your friend.

Window number 3

Below there are two alternative lists of incomes A and B (in the same currency). Each list represents the five possible outcomes of the A-job and the B-job respectively after you have accepted it.

Please state which policy you consider would result in the higher risk for yourself by clicking the appropriate button . . .

*A more risky
*B more risky
*Same risk in A&B

[Windows 4–8 follow the same format, with vectors for each question as in Table A.1].

Window number 9 – Background to Part 2

The next question is about views. You will be presented with a hypothetical income change and some possible views about the effects on risk of that change. Please select the view that corresponds most closely to your own. You can check more than one answer, provided that you consider the answers do not contradict each other. You will have the opportunity to add a comment that explains the reason for your choice.
Window number 10 – Verbal Question

A job-offer is characterised by a number of equally likely positions: which position is the relevant one is unknown until after the job is accepted. Associated with each possible position is a specific income level. Suppose the job offer is changed by transferring some income from a relatively high-paid position to a relatively low-paid position, without changing the income associated with any other position. The transfer is not so large as to make the high-paid position worse than the low-paid position, but it may alter their income rankings relative to the other, unaffected positions.

(a) The job-offer must become more attractive if the ranking by income of all the positions remains the same. If there is any change in the income ranking of the positions then it is possible that it becomes less attractive or remains the same.

(b) If the transfer is from the highest-paid to the lowest-paid position, and after the transfer the highest-paid position remains the highest and the lowest-paid remains the lowest, then the job-offer must become more attractive. In other cases we cannot say a priori whether or not it will become more attractive.

(c) The transfer may change the relative income-ranking of other positions. So we cannot say a priori whether or not the job-offer will become more attractive.

(d) The job-offer must become more attractive, even if there is a change in the income ranking of the positions as a result of this transfer, and even if the transfer is not from the highest-paid to the lowest-paid position.

(e) None of the above.

In the light of your answer to this question do you want to change your answer to any of the other questions? If so, please use the navigation bar to return to the previous pages.

Do you want to add a comment of your own?

See Section A.5 for the three final windows which collected individual characteristics of the respondents.

A.2 Risk-friend Version

Window number 2 – Background to Part 1

You are advising a friend who has to make a choice between two job offers A and B. The monetary payoff to either job offer is not known with certainty. In job A or job B your friend could, with equal probability, be assigned to any one of five
different positions with known incomes. Apart from the income prospects you and
your friend believe the jobs to be equally attractive.

In each of the following six questions two alternative lists of incomes A and
B (in the same currency) are given. Each of these pairs represents the outcomes
of the A-job and the B-job in terms of the monetary rewards in each of the five
possible positions. In each case please state which job offer you consider would
present the higher risk for your friend.

Window number 3

Below there are two alternative lists of incomes A and B (in the same currency).
Each list represents the five possible outcomes of the A-job and the B-job
respectively after your friend has accepted it.

Please state which policy you consider would result in higher risk for your friend
by clicking the appropriate button . . .

*A more risky
*B more risky
*Same risk in A&B

[Windows 4–8 follow the same format, with vectors for each question as in
Table A.1].

Window number 9 – Background to Part 2

The next question is about views. You will be presented with a hypothetical
income change and some possible views about the effects on risk of that change.
Please select the view that corresponds most closely to your own. You can check
more than one answer, provided that you consider the answers do not contradict
each other. You will have the opportunity to add a comment that explains the
reason for your choice.

Window number 10 – Verbal Question

A job-offer is characterised by a number of equally likely positions: which
position is the relevant one is unknown until after the job is accepted. Associated
with each possible position is a specific income level. Suppose the job offer is
changed by transferring some income from a relatively high-paid position to a
relatively low-paid position, without changing the income associated with any
other position. The transfer is not so large as to make the high-paid position worse
than the low-paid position, but it may alter their income rankings relative to the
other, unaffected positions.
Perceptions of Inequality and Risk

(a) The risk of the job-offer must fall if the ranking by income of all the positions remains the same. If there is any change in the income ranking of the positions then it is possible that risk increases or remains the same.
(b) If the transfer is from the highest-paid to the lowest-paid position, and after the transfer the highest-paid position remains the highest and the lowest-paid remains the lowest, then risk must fall. In other cases we cannot say a priori how risk will change.
(c) The transfer may change the relative income-ranking of other positions. So we cannot say a priori how risk will change.
(d) Risk must fall, even if there is a change in the income ranking of the positions as a result of this transfer, and even if the transfer is not from the highest-paid to the lowest-paid position.
(e) None of the above.

In the light of your answer to this question do you want to change your answer to any of the other questions? If so, please use the navigation bar to return to the previous pages.

Do you want to add a comment of your own?

See Section A.5 for the three final windows which collected individual characteristics of the respondents.

A.3 Preference-self Version

Window number 2 – Background to Part 1

You are considering a choice between two job offers A and B. The monetary payoff to either job offer is not known with certainty. In job A or job B you could, with equal probability, be assigned to any one of five different positions with known incomes. Apart from the income prospects you believe the jobs to be equally attractive.

In each of the following six questions two alternative lists of incomes A and B (in the same currency) are given. Each of these pairs represents the outcomes of the A-job and the B-job in terms of the monetary rewards in each of the five possible positions. In each case please state which job-offer you consider would present the better prospects.

Window number 3

Below there are two alternative lists of incomes A and B (in the same currency). Each list represents the five possible outcomes of the A-job and the B-job respectively after you have accepted it.
Please state which policy you consider would present the better prospects for you by clicking the appropriate button... 

*A better
*B better
*Same for A&B

[Windows 4–8 follow the same format, with vectors for each question as in Table A.1].

Window number 9 – Background to Part 2

The next question is about views. You will be presented with a hypothetical income change and some possible views about the effects on risk of that change. Please select the view that corresponds most closely to your own. You can check more than one answer, provided that you consider the answers do not contradict each other. You will have the opportunity to add a comment that explains the reason for your choice.

Window number 10 – Verbal Question

A job-offer is characterised by a number of equally likely positions: which position is the relevant one is unknown until after the job is accepted. Associated with each possible position is a specific income level. Suppose the job offer is changed by transferring some income from a relatively high-paid position to a relatively low-paid position, without changing the income associated with any other position. The transfer is not so large as to make the high-paid position worse than the low-paid position, but it may alter their income rankings relative to the other, unaffected positions.

(a) The job-offer must become more attractive if the ranking by income of all the positions remains the same. If there is any change in the income ranking of the positions then it is possible that it becomes less attractive or remains the same.

(b) If the transfer is from the highest-paid to the lowest-paid position, and after the transfer the highest-paid position remains the highest and the lowest-paid remains the lowest, then the job-offer must become more attractive. In other cases we cannot say a priori whether or not it will become more attractive.

(c) The transfer may change the relative income-ranking of other positions. So we cannot say a priori whether or not the job-offer will become more attractive.

(d) The job-offer must become more attractive, even if there is a change in the income ranking of the positions as a result of this transfer, and even if the transfer is not from the highest-paid to the lowest-paid position.

(e) None of the above.
In the light of your answer to this question do you want to change your answer to any of the other questions? If so, please use the navigation bar to return to the previous pages.
Do you want to add a comment of your own?

See Section A.5 for the three final windows which collected individual characteristics of the respondents.

A.4 Preference-friend Version

Window number 2 – Background to Part 1
You are advising a friend who has to make a choice between two job offers A and B. The monetary payoff to either job offer is not known with certainty. In job A or job B your friend could, with equal probability, be assigned to any one of five different positions with known incomes. Apart from the income prospects you and your friend believe the jobs to be equally attractive.

In each of the following six questions two alternative lists of incomes A and B (in the same currency) are given. Each of these pairs represents the outcomes of the A-job and the B-job in terms of the monetary rewards in each of the five possible positions. In each case please state which job-offer you consider would present the better prospects for your friend.

Window number 3
Below there are two alternative lists of incomes A and B (in the same currency). Each list represents the five possible outcomes of the A-job and the B-job respectively after your friend has accepted it.

Please state which policy you consider would present the better prospects for your friend by clicking the appropriate button . . .
*A better
*B better
*Same for A&B
[Windows 4–8 follow the same format, with vectors for each question as in Table A.1].

Window number 9 – Background to Part 2
The next question is about views. You will be presented with a hypothetical income change and some possible views about the effects on risk of that change. Please select the view that corresponds most closely to your own. You can check more
than one answer, provided that you consider the answers do not contradict each other. You will have the opportunity to add a comment that explains the reason for your choice.

Window number 10 – Verbal Question

A job-offer is characterised by a number of equally likely positions: which position is the relevant one is unknown until after the job is accepted. Associated with each possible position is a specific income level. Suppose the job offer is changed by transferring some income from a relatively high-paid position to a relatively low-paid position, without changing the income associated with any other position. The transfer is not so large as to make the high-paid position worse than the low-paid position, but it may alter their income rankings relative to the other, unaffected positions.

(a) The job-offer must become more attractive if the ranking by income of all the positions remains the same. If there is any change in the income ranking of the positions then it is possible that it becomes less attractive or remains the same.

(b) If the transfer is from the highest-paid to the lowest-paid position, and after the transfer the highest-paid position remains the highest and the lowest-paid remains the lowest, then the job-offer must become more attractive. In other cases we cannot say a priori whether or not it will become more attractive.

(c) The transfer may change the relative income-ranking of other positions. So we cannot say a priori whether or not the job-offer will become more attractive.

(d) The job-offer must become more attractive, even if there is a change in the income ranking of the positions as a result of this transfer, and even if the transfer is not from the highest-paid to the lowest-paid position.

(e) None of the above.

In the light of your answer to this question do you want to change your answer to any of the other questions? If so, please use the navigation bar to return to the previous pages.

Do you want to add a comment of your own?

See Section A.5 for the three final windows which collected individual characteristics of the respondents.

A.5 VRP Personal Characteristics – All Questionnaires

The numerical questions referred to the same vectors in the four versions (Table 8). Finally, the last section of the experiment was the same in the four versions of the questionnaire:
Window number 11 – Personal characteristics 1

Finally, we would be grateful for some information about yourself:

Are you male or female? M/F
What is your age? XX years
What is your special subject of study?
Were you employed before university? Yes/No
How would you rate your political views? Please select one of the options on the scale below:
Extreme left/Extreme right \([1–7 \text{ scale}]\)
How would you rate your family’s income in 1990? Please select one of the options on the scale below.
Very poor/Very rich \([1–7 \text{ scale}]\)
How would you rate your own income prospects in the year 2010? Please select one of the options on the scale below.
Very poor/Very rich \([1–7 \text{ scale}]\)

Window number 12 – Personal characteristics 2

Finally we would be very grateful for your reactions to this questionnaire:

• How frequently do you use the Internet?
• Have you completed an Internet questionnaire before?
• Did you find the navigation bar useful?
• Did the verbal question help to clarify the issue in the numerical questions?
• Did you consult anyone else while filling out the questionnaire?
• Roughly how long did you need to complete the questionnaire?
• Which was the principal language that you used?
• If another language had been available which would have been the most useful?

Window number 11 – Good bye/thank you

Thank you for taking part in the questionnaire. Your responses will be useful in further research on risk.

APPENDIX B: THE PIR QUESTIONNAIRES

The PIR experiment was carried out by Amiel and Cowell (2002) using paper questionnaires. We reproduce an exact version of the two types of questionnaires (inequality and risk) in the following pages.\(^\text{10}\)
References cited in the text must appear in the reference list; conversely, each entry in the reference list must be cited in the text. The author must make certain that each source referenced appears in both places and that the text citation and reference list entry are identical in spelling and year.