Papeles de Trabajo

COMPARING INEQUALITY AND RISK AVERSION IN HEALTH AND INCOME: AN EMPIRICAL ANALYSIS USING HYPOTHETICAL SCENARIOS WITH LOSSES

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ABSTRACT

Four kinds of distributional preferences are compared: inequality aversion in health, inequality aversion in income, risk aversion in health, and risk aversion in income. Face to face interviews of a representative sample of the general public are undertaken using hypothetical scenarios involving losses in either health or income. The results imply that the four distributional preferences were statistically significantly different from each other, with inequality aversion in household income the strongest, followed by risk aversion in household income, then risk aversion in individual health, with inequality aversion in individual health coming last. [92wds]

JEL codes: I14, D63, D71, D81.

Key words: inequality, risk, aversion, health, income, public preferences.

1. INTRODUCTION

Individual utility contributes to social welfare. However, social welfare depends not only upon the aggregate of individual utilities (concern for efficiency), but arguably also upon how the total is distributed across the individuals (concern for equality). This leads to the need to quantify the efficiency-equality trade-off, or the level of inequality aversion, that is relevant in public policy decisions. One way in which to address this issue is to explore the trade-off supported by members of the public. In doing so, there are four things to consider: the distribuendum; the relationship between inequality and risk; the relationship between individual utility and social welfare; and the survey methodology. Each is addressed below.

First, the level of inequality aversion people hold may depend on the distribuendum, i.e. the thing that is distributed unequally. If utility is defined as a function of individual consumption, then individual utility can be (indirectly) expressed as a function of income, given prices. On the other hand, there are fundamental aspects of human wellbeing that do not have an obvious market or price. Health is one such example. While health may affect the individual's employability and thus their income, the most simplistic indirect utility function fails to capture the direct effect of health on individual utility. This may lead to a multi-dimensional notion of welfare (Atkinson, Bourguignon, 1982). Arguably, health and income are two fundamental elements of human wellbeing across which we might expect people to be inequality averse. Tobin (1970) discussed "specific egalitarianism", under which inequality in certain basic necessities (such as health) should be lower than the inequality in general ability to pay (i.e. income), implying a higher inequality aversion for health than income. More recently, Anand (2002) has argued that aversion to health inequality should be higher than aversion to income inequality. He argues that first, health is a special good, with intrinsic value; and second, while there may be situations where income inequality is acceptable (e.g. increase in overall size of the pie may enable trickle down effects), there are no parallel examples for health. (Also see Hausman, 2007.) This study examines whether people have different levels of aversion to health inequality and income inequality.

Second, a simple inequality averse social welfare function involves diminishing marginal social welfare, and therefore can also be risk averse. However, the two have different conceptual bases. Suppose there are two prospects of equal expected value, affecting two individuals, *i* and *j*:

I. [I for inequality] Randomly, either i or j gains one unit of good and the other gains nothing;

R. [R for risk] Randomly, either both individuals gain one unit of good each; or both individuals gain nothing.

While an inequality averse and risk neutral social welfare function will place R above I, a risk averse and inequality neutral social welfare function will place I above R. Similar scenarios have been used by Keller and Sarin (1988) to examine how a sample of university students perceived equity of the allocation of risks within an imaginary island community facing predicted losses in lives. They found that respondents preferred R over I. Other studies have also shown that people prefer R over I when allocating income (Kroll and Davidovitz, 2003; Carlsson et al, 2005), and this study aims to add new evidence to this literature.

Third, the focus of our study is the social welfare function, and not the individual utility function. Let us assume individual utility is a function of own consumption, and social welfare is a function of utility levels of composite individuals. While social welfare functions can reflect attitudes to uncertainty and inequality, selfish individual utility functions can only reflect attitudes to uncertainty, and not inequality per se. Thus, in the above example with the two prospects, an individual choosing strictly for him or herself will have no preference between I and R. Although a risk averse individual utility function can be consistent with inequality aversion at the aggregate level because a more egalitarian distribution also reduces individual's risk, this is not the focus of our study. Furthermore, individual utility may be relaxed to include relative income and position, and/or externalities such as altruism; but while these are affected by the distribution across society, ultimately, they are based on how the distribution appears to the individual. However, individuals may (and usually do) have an additional meta-level detached preference over distributions per se, and these 'societal' or 'citizen' preferences, which we interpret as the basis of the social welfare function, may indeed be inequality (and risk) averse. And it is these that we aim to examine.

Fourth, such preferences are not revealed through market transactions, leaving researchers with the direct questioning of individuals through lab-based experiments or questionnaire-based surveys to

obtain stated or expressed preferences. The obvious challenge associated with these is the validity of the results. The exercises are typically either 'real' and involve actual monetary payments but the amounts are (by practical necessity) relatively modest, or unincentivised and deal with large monetary sums or potential mortality but the outcomes are (again, by practical necessity) completely hypothetical (for a detailed discussion, see Amiel and Cowell, 1999; Gaertner and Schokkaert, 2012). Furthermore, while a number of stated preference studies have examined empirical support for inequality aversion, most have relied on student samples (see for example, Amiel and Cowell, 1999; Bolton and Ockenfels, 2002; Engelmann and Strobel, 2004; Amiel *et al*, 2012). University students only represent a relatively small, young, and privileged portion of the wider public; while they may be better suited to more cognitive exercises they are arguably less ideal for topics involving normative judgements (see for example Abásolo and Tsuchiya, 2008, on the effect of age). As an alternative method, Schwarze and Härpfer (2007) used a large scale general population survey to model variations in self-reported subjective well-being (or life satisfaction) by variation in real income inequality. They argue that "life satisfaction not only measures individual utility, but also reflects aspects of social utility" (p. 237). Ferrer-i-Carbonell and Ramos (2010) use this approach to examine whether the negative impact of local income inequality on self-reported life satisfaction can be explained by individual risk aversion measured by self-reported preparedness to take risks. They do this by using life satisfaction as a proxy for inequality aversion once a whole host of individual and household characteristics are controlled for, and demonstrate that this and risk aversion are two related but separate preferences. However, the approach relies crucially on the assumption that once variation in satisfaction with one's own life is modelled in terms of individual and household variables, the residual can be interpreted to reflect inequality aversion held by the individual.

In total, this paper addresses four issues: inequality aversion in health; risk aversion in health; inequality aversion in income; and risk aversion in income. Some of the individual components have been researched, but not all, and not within one single survey, with general public respondents. These will be pursued using face to face, unincentivised interviews of members of the general public where hypothetical questions examining peoples' meta-preferences are asked. In the below, section 2 outlines the design of the questions and the method of analysis, section 3 reports the results, section 4 discusses the findings, and section 5 concludes.

2. METHODS

2.1. Design of questions

This sub-section addresses three issues: what the unit of analysis is; what the relevant time horizon is; and whether to deal with gains or losses.

The previous literature examining inequality aversion in health has used inequalities in life expectancy at birth, a measure of *individual lifetime health* (for example, Abásolo and Tsuchiya, 2004, 2013; Dolan and Tsuchiya, 2005). Thus, a natural extension of this would be to contrast it with inequality in *individual lifetime income*, and then to expand into the context of risk. This leads to the first two points. The first point concerns the unit of analysis: while health primarily affects individuals, income affects households. For example, transferability of health is limited so that, unless the condition is contagious, one family member becoming ill need not make the rest of the family also ill; or, a healthy family member cannot transfer their health to an ill member. On the other hand, money is substantially more transferable than health so that one family member losing their job can have immediate financial implications for the rest of the family; equally, income from another member of the family can make up for in the lost income. Indeed, a household is a unit where income is shared across members. A related issue concerns measurement: while it is possible to measure household income, it is not possible to measure household health. These suggest that the natural measure of health is at the individual level, whilst the natural measure of income is at the household level. Therefore, individual health and household income are used as the units of analysis in this study.

The second point concerns the timeframe: lifetime health and lifetime income typically have a positive correlation, and the causality can go in either direction. Chronic poverty is likely to have adverse effects on health, and serious illness can affect employability and income. If it is not credible to survey respondents that lifetime health and lifetime income are independent of each other, then this will make

it difficult to isolate them in the interview scenarios. One way to minimise this problem is to consider changes in health and income over a limited duration of time, which is what is done in this study.

Regarding the third point, a decision was made in this study to use scenarios in losses rather than gains. This involved two considerations. Firstly, while it is straightforward to present scenarios in which households experience a significant increase in income for a fixed duration, it is less practical to build scenarios in which individuals experience a significant increase in health for a fixed duration, because most people are already reasonably healthy. Introducing some artificially lowered level of baseline health and baseline income to start with would accommodate gains, but this would mean an additional layer of complexity to the scenarios. Secondly, respondents may find loss scenarios more credible, where income and health are simply lost for a fixed period, compared to gain scenarios, where respondents may want to know how they are generated and/or why they cannot be sustained.

These considerations have led to the decision to measure health in terms of serious illness affecting individuals for a limited duration, and to measure income in terms of lost household income for a limited duration.

The inequality questions use scenarios that are similar to I above and contrast them with a reference scenario with no inequality (or risk); the risk questions use scenarios that are similar to R above and contrast them with the same reference scenario. Note that the I-type scenarios and the R-type scenarios are not compared to each other directly within a question. All of the scenarios involve losses over specified numbers of weeks: e.g. seriously ill for two weeks; or losing two weeks' income. The four questions are designed so that they are as similar as possible, allowing the differences observed to be attributed to the parameters of interest.

All the questionnaires use the perspective of a policy maker. In other words, the survey aims to explore the parameters of a social welfare function that the respondents would support, rather than the parameters of their own individual utility function. The questionnaire survey is helped by a visual representation of various scenarios, where respondents choose one scenario over the other, or choose indifference between the two. Each scenario depicts the health, or income, of two population groups. There are four null hypotheses, namely, that people have societal level preferences with no differences between the following:

- Inequality aversion and risk aversion regarding losses in health (IH vs RH).
- Inequality aversion and risk aversion regarding losses in income (IY vs RY).
- Inequality aversion regarding losses in health and losses in income (IH vs IY).
- Risk aversion regarding losses in health and losses in income (RH vs RY).

In each question, the respondent is asked to imagine a hypothetical community of 1000 individuals across 250 households of four people each, facing the prospect of a loss for certain, affecting all people in the community over the next year. In the two health questions (IH and RH), the loss is for individuals to become seriously ill for two weeks, and in the two income questions (IY and RY) the loss is for households to lose two weeks' income. In all the questions, respondents are then presented with four pairwise scenarios each made up of alternatives A and B, where alternative A varies across the pairs. Outcome of alternative B is the reference and involves no inequality or risk: throughout, it is fixed at all 1000 people (across 250 households) facing a two-week loss for certain. Alternative A varies across the four pairs in the same manner across all four questions and consists of (an expected) 500 people (across 125 households) experiencing: a three, four, five, or six-week loss, in this order, while those unaffected suffer no loss. In the inequality questions (IH and IY) the number, 500, that experiences the loss is for certain. In the risk questions (RH and RY) the expected number, 500, arises from a 50 for 100 chance that all 1000 will experience the loss, and a 50 for 100 chance that none will experience the loss.

For each of the four scenario pairs, respondents are asked to indicate whether they would choose A, choose B, or that A and B are equivalent. Inequality or risk neutrality is achieved by being indifferent on the second scenario pair, where the loss in alternative A is for four weeks. An even number of scenario pairs was chosen so that the neutral pair does not appear in the middle of the sequence of pairs. A typical respondent is expected to choose A on the first scenario pair, and shift to selecting B at some stage during the following scenario pairs. Once the respondent chooses B (or, if the

respondent chooses B at the first pair), the subsequent scenarios are not asked, so as to minimise noise and imprecision. Table 1 summarises these four questions.

Table 1

THE LOSSES ASSOCIATED WITH ALTERNATIVE A IN EACH TYPE OF QUESTION

	Health (H)	**Income (Y)**
Inequality (I) (No uncertainty)	**IH**: 500 individuals become seriously ill for X weeks	**IY**: 500 individuals across 125 households loose X weeks' income
Risk (R) (No inequality)	**RH**: 50 for 100 chance that all 1000 individuals become seriously ill for X weeks	**RY**: 50 for 100 chance that all 1000 individuals loose X weeks' income

1. Alternative B is fixed at 1000 individuals experiencing the loss for two weeks.
2. X takes values 3, 4, 5, 6 across four scenario pairs.
3. In all questions, X=4 represents neutrality.

In addition, the survey includes a fifth question, also asked to all respondents, after the four questions above. The aim of this exploratory question is to allow the identification of an exchange rate between weeks of ill health and weeks of income loss for each respondent. This "income-equivalent health" question uses a visual aid similar to the previous questions and asks the respondent to indicate across a series of scenario pairs whether they chose A, or B, or they were equally good. This time, alternative A is fixed at 1000 individuals experiencing serious illness for one week *and* six week's income loss. Alternative B has a fixed level of five weeks of serious illness for everybody, combined with five, four, three, two, one, or zero weeks of income loss for everybody. This last question involves no inequality or risk.

The questionnaires have two versions both covering the same questions: in one version the first four questions are asked in the order IH, RH, IY, RY (health first); whilst in the other version the order is IY, RY, IH, RH (income first). By pooling the analysis across the two versions, potential biases arising from the ordering of the topics can be cancelled out. In both versions, the inequality questions in health or in income are asked before the corresponding risk questions, because the latter are more complex and regarded more difficult. The income-equivalent health question always comes last. Any potential bias introduced by these is not explored within this study.

The survey also includes information on demographic, socio-economic and other relevant characteristics of the respondents (such as self-reported health state or attitudes towards certain public goods as charity or blood donation). Of the five questions, the IH question with the visual aid, the visual aid for the RY question, and the visual aid for the income-equivalent health question are reproduced in the Appendix. (The complete set is available on request.)

2.2. Method of analysis

Three sets of analysis are carried out: the first groups the responses into ordinal categories; the second treats responses cardinally and analyses them assuming constant relative aversion; and the third builds on this but replaces the assumption with constant absolute aversion.

2.2.1. *Ordinal categories of aversion*

In the first set of analysis, responses are grouped into nine categories of aversion, capturing the stage at which they switch from alternative A to B (Table 2). The first and last categories are for selecting either A or B throughout, without switching. The stronger the aversion to inequality or risk, the earlier will be the switch from A to B. Across the four main questions, indifference in the second scenario pair corresponds to neutrality. Scenario A of the first pair (three weeks' loss) is a 25 for 100 reduction in loss from this; and scenario A for the third and fourth pairs are a 25 for 100 increment and a 50 for 100 increment from this. Thus, by assuming constant relative aversion (or scale independence), the response patterns are directly comparable across any of the *combinations* of questions (viz. IH vs RH, etc).

Table 2

AVERSION PARAMETER INTERVALS AND FREQUENCIES FOR EACH RESPONSE PATTERN

Response pattern	Type of preference	IH n (%)	RH n (%)	IY n (%)	RY n (%)	Constant relative aversion parameter	Constant absolute aversion parameter
1: B B B B	B at the first scenario pair	83 (20.5)	101 (24.4)	161 (38.9)	119 (28.7)	$0.710 < r_R < 137.976$	$0.481 < r_A < 69.300$
2: = B B B	Indifferent at the first scenario pair, and B at the second	2 (0.5)	1 (0.2)	0 (0.0)	3 (0.7)	$r_R = 0.710$	$r_A = 0.481$
3: A B B B	A at the first scenario pair, and B at the second	94 (22.7)	129 (31.2)	97 (23.4)	135 (32.6)	$0 < r_R < 0.710$	$0 < r_A < 0.481$
4: A = B B	A at the first scenario pair, indifferent at the second and B at the third	45 (10.9)	27 (6.5)	39 (9.4)	27 (6.5)	$r_R = 0$	$r_A = 0$
5: A A B B	A at the first two scenario pairs, and B at the third	101 (24.4)	91 (22.0)	65 (15.7)	75 (18.1)	$-0.244 < r_R < 0$	$-0.164 < r_A < 0$
6: A A = B	A at the first two scenario pairs, indifferent at the third, and B at the fourth	5 (1.2)	4 (1.0)	2 (0.5)	6 (1.5)	$r_R = -0.244$	$r_A = -0.164$
7: A A A B	A at the first three scenario pairs, and B at the last	22 (5.3)	15 (3.6)	12 (2.9)	16 (3.9)	$-0.369 < r_R < -0.244$	$-0.241 < r_A < -0.164$
8: A A A =	A at the first three scenario pairs, and indifferent at the last	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	$r_R = -0.369$	$r_A = -0.241$
9: A A A A	A throughout the four scenario pairs	62 (15.0)	46 (11.1)	38 (9.2)	33 (8.0)	$r_R < -0.369$	$r_A < -0.241$
TOTAL		414 (100)	414 (100)	414 (100)	414 (100)		

Building on the ordinal nature of the nine categories, a cumulative function is drawn for each question, so that stronger the aversion across respondents, the higher will be the position of the corresponding curve. The Wilcoxon sign rank test (Wilcoxon, 1945) is used to compare across the cumulative functions of the four pairs of questions.

2.2.2. *Cardinal levels of aversion assuming constant relative aversion*

In the second set of analysis, a cardinal level of aversion is assigned to each observation. Let us assume a social welfare function $W = f(X_i, X_j)$, where X represents wellbeing (either in health or income); for the inequality questions, subscripts i and j represent two homogeneous groups of individuals of equal size; for the risk questions, i and j represent two different states of the world.

One established measure of aversion to inequality or to risk is relative aversion, which is defined as $-XW''/W'$. An example of a social welfare function with constant relative aversion for wellbeing losses is $W_R(X) = -|X|^{1+r_R}$, where $X \leq 0$. Here, r_R is the constant relative aversion parameter, which is 0 for neutrality, positive for aversion, and negative for inequality or risk seeking. The (expected) social welfare for each scenario can be expressed as:

$$E(W_R) = -q_i|X_i|^{1+r_R} - q_j|X_j|^{1+r_R}$$

Here, in the case of inequality aversion, q is the relative size of the two groups; and for risk aversion, q is the probability of the two possible outcomes.

If the respondent is indifferent between (X_i^A, X_j^A) for scenario A and (X_i^B, X_j^B) for scenario B, then $W_R(X^A) \cong W_R(X^B)$, so

$$-q_i\left|X_i^A\right|^{1+r_R} - q_j\left|X_j^A\right|^{1+r_R} \cong -q_i\left|X_i^B\right|^{1+r_R} - q_j\left|X_j^B\right|^{1+r_R}$$

In our design, $q_i = q_j = 0.5$; the value of X_i^A is fixed at 0; and $X_i^B = X_j^B = -2$ throughout. Therefore, the value of r_R can be calculated for the different levels of X_j^A used in the survey:

$$r_R = \frac{\ln 0.5}{\ln 2 - \ln(-X_j^A)} - 1$$

Note, the social welfare function assumes strong monotonicity and thus is unspecified for $X_j^A \geq -2$ (we assume the smallest possible loss for X_j^A is 2.01 weeks).

Third, the actual observations are made up of point data (when a respondent is indifferent at a given scenario pair), interval data (when a respondent either switches from A to B, or prefers B throughout), left censored data (when a respondent chooses A throughout), making it not possible to identify a specific level of aversion in all cases. Therefore, four interval regressions (Cameron and Trivedi, 2009) are used to estimate the levels of aversion as a function of a set of explanatory variables (STATA 11 is used). These include: demographic (age and gender); socioeconomic (education and employment status); health (self-assessed health sate); attitudes to public goods and free-riding (whether the individual donates to charity or blood); and respondent comprehension (whether the interviewer felt the respondent needed a lot of help). The estimated question-based models are then used to predict the relative aversion parameter at the point of indifference for each question for each respondent.

To test the four hypotheses, regression models are run for the four combinations of questions by pooling the data across the relevant questions and including a question dummy. The same set of covariates as above is used. Random effects interval estimations are used to account for the non-independent multiple observations provided by the same respondents. The sign and significance of the question dummy allow a quantitative test of whether or not each of the four null hypotheses can be rejected.

2.2.3. *Cardinal levels of aversion assuming constant absolute aversion*

Imagine a respondent considering, for example, the first scenario pair, where scenario A involves for half the population a three-week loss while a neutral scenario would involve a four-week loss. Constant relative aversion would be appropriate if respondents perceive this difference in proportional terms (ie. 25 for 100 less loss). If, however, respondents perceive the difference in terms of absolute units (ie. one week less loss), then constant absolute aversion would be more appropriate.

Therefore, a third set of analysis replaces the assumption of constant relative aversion with the assumption of constant absolute aversion (or translation independence). Absolute aversion to inequality or risk is defined as $-W''/W'$. An example of a social welfare function with constant absolute aversion is:

$$W_A = \begin{cases} -r_A e^{-r_A X} \ \ if\ r_A \neq 0 \\ -X \ if\ r_A = 0 \end{cases}$$

where $X \leq 0$ and r_A is the constant absolute aversion parameter. This is 0 for neutrality, positive for aversion, and negative for inequality or risk seeking. Using the same notations i, j, and q as above, (expected) social welfare for each scenario is:

$$E(W_A) = -q_i(-r_A)e^{-r_A x_i} - q_j(-r_A)e^{-r_A x_j}$$

In terms of our design, in order to assume constant absolute aversion, the absolute units of wellbeing need to be comparable across pairs of questions. This means that, combinations that go *across* domains (ie. inequality in health and in income; risk in health and in income) are not comparable. This is addressed by the exploratory income-equivalent health question: for example, the three weeks' of serious illness can be expressed in terms of an equivalent number of weeks' of income loss which is regarded as equally bad. Assuming separability between social welfare from health and social welfare from income, the marginal rate of substitution (MRS) represents the number of weeks' of income required to compensate for one week of serious illness, at a point of indifference. This can be approximated as:

$$MRS \cong -\frac{y^B - y^A}{h^A - h^B}$$

where *h* represents the number of weeks of serious illness and *y* represents the number of weeks' of income loss in each scenario. Therefore, suppose a respondent is indifferent on the third pair of scenarios, where, scenario A involves everybody experiencing serious illness for one week *and* six week's income loss; and scenario B has five weeks of serious illness *and* three weeks of income loss for everybody. One week of serious illness is then equivalent to losing 3/4 weeks' income.

The responses to the two health questions (IH and RH) are converted into income-equivalents (IHE and RHE) in three stages. First, an interval regression model is fitted to the data from the income-equivalent health question: in order to satisfy strong monotonicity, y^B cannot be equal or lower than -6, so in the estimation process we have imposed a maximum loss of 5.99 weeks for y^B). Second, using this, a point estimate is predicted for each respondent. Third, this value is used to convert the data on the IH and RH questions from range of numbers of health weeks into range of number of income-equivalent weeks at the individual respondent level.

Next, the aversion parameters are derived from the numbers of weeks of loss. As before, where the respondent is indifferent between (X_i^A, X_j^A) and (X_i^B, X_j^B), then $W_A(X^A) \cong W_A(X^B)$, so

$$-q_i e^{-r_A X_i^A} - q_j e^{-r_A X_j^A} = -q_i e^{-r_A X_i^B} - q_j e^{-r_A X_j^B}$$

Again, since $q_i = q_j = 0.5$; the value of X_i^A is fixed at 0; and $X_i^B = X_j^B = -2$, therefore:

$$e^{-r_A X_j^A} - 2e^{2r_A} + 1 = 0$$

The value of r_A cannot be obtained mathematically. Instead, it is obtained from the value of X_j^A at the indifference point, using the "solve" tool in MS Excel. As with the constant relative aversion, the social welfare function satisfies strong monotonicity, and therefore is not specified for $X_j^A \geq -2$ (the same smallest possible loss of 2.01 weeks is imposed). The procedure to predict inequality and risk aversion parameters at the individual level and the corresponding descriptive statistics used are the same as those explained above for constant relative aversion.

3. RESULTS

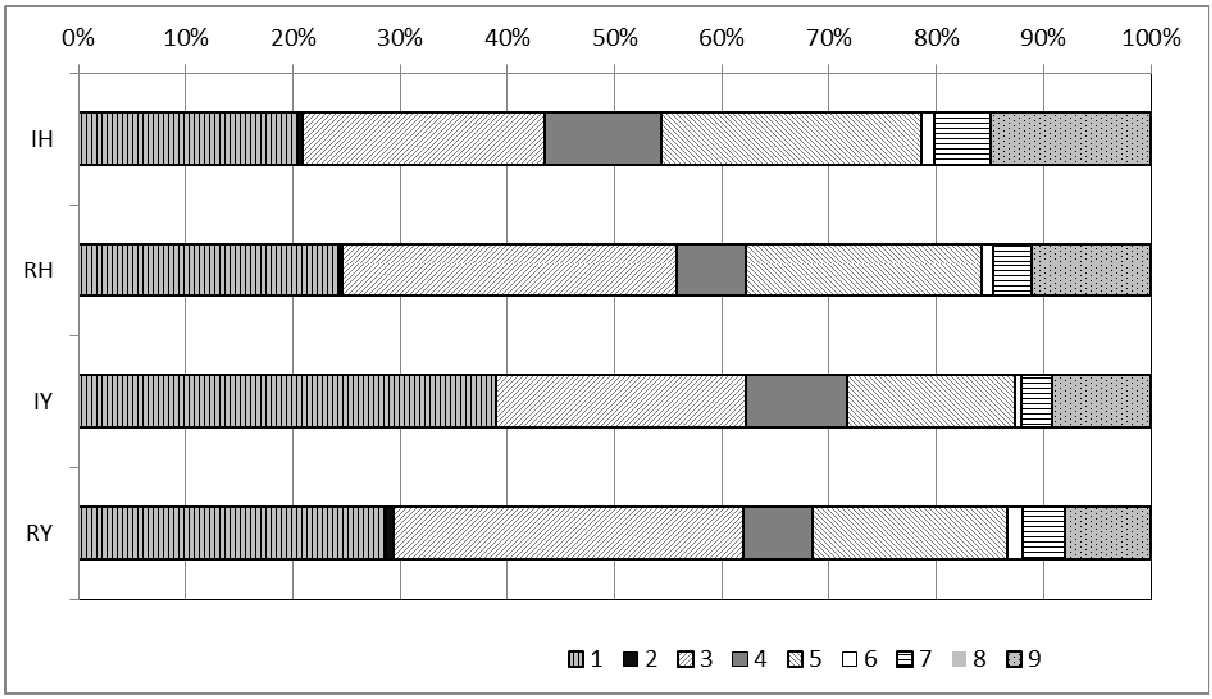
Face to face interviews of 422 individuals over the age of 18 was undertaken by Opinometre S.L. (a Spanish commercial survey company) in and around Madrid and Barcelona in Spain in July 2012. Interviews were undertaken in the respondent's home. Recruitment followed set quotas for age and sex, and as a result the achieved sample is representative in these variables: 48.3 for 100 of the respondents were male, with average age of 45.8 (SD 17.1); and 51.7 for 100 female, with average age of 46.8 (SD 17.0).

Of the sample, eight respondents were excluded (resulting in 414 valid cases). Of these, four were excluded for indicating indifference at more than one scenario pair in at least one of the four main questions; another respondent was excluded for doing the same in the fifth question; and one respondent was excluded because of missing values in covariates. Across all the question pairs, most respondents chose either alternative A or B, and few indicated indifference (see columns 3-6 of Table 2). The two versions of the questionnaire (health first, n = 205; and income first, n = 209) did not significantly affect the results of IH, RH and RY (chi-square tests: $p = 0.536$; $p = 0.243$; and $p = 0.762$, respectively) but did affect the results of IY ($p = 0.017$) so that those with the health question first showed a stronger aversion to income inequalities than those with the income question first. All subsequence analyses pool across the two versions, and therefore are not affected by this.

The stacked bar chart in Figure 1 summarises the results across the nine relative aversion categories. In IH, just under half (45.9 for 100) are inequality seeking while a similar proportion (43.7 for 100) are inequality averse. In the remaining three questions, the majority are averse. The location and width of category 4 for neutrality differs across the questions. Prevalence of neutrality ranges from the 6.5 for 100 for risk questions (both RH and RI) to 9.4 for 100 for IY and the highest at 10.9 for 100 for IH. The median respondent for each question demonstrates neutral preference for IH, and averse in RI, IY and RH.

Figure 1

INDIVIDUALS REPORTING DIFFERENT RELATIVE AVERSION CATEGORIES (NUMBER AND PERCENTAGES: N=414)



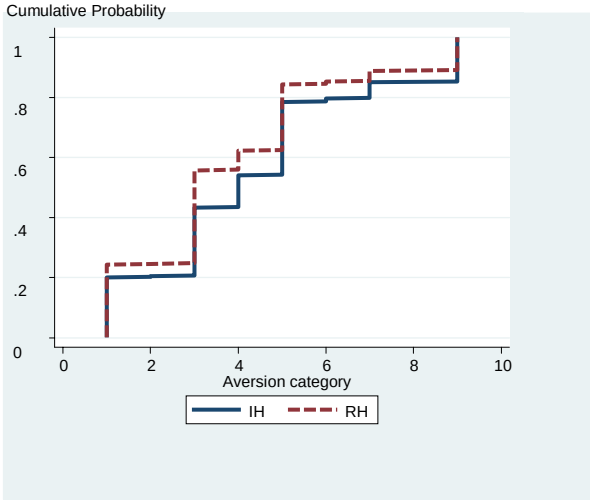
NB: The relative aversion categories range from 1 (maximum aversion) to 9 (minimum aversion), with 4 for neutrality. The numbers indicate the numbers of respondents. All questions add up to 414 respondents.

Figure 2 illustrates the cumulative distributions of each relevant pair of questions. The results of the Wilcoxon sign rank tests show that in the health context (IH vs RH) risk aversion is stronger than inequality aversion ($p < 0.001$); but in the income context (IY vs RY), there is only marginally significant difference ($p = 0.046$). Furthermore, across the contexts, aversion to inequality (IH vs IY) and aversion to risk (RH vs RY) are both stronger in income than in health ($p < 0.001$ and $p = 0.002$, respectively).

Figure 2

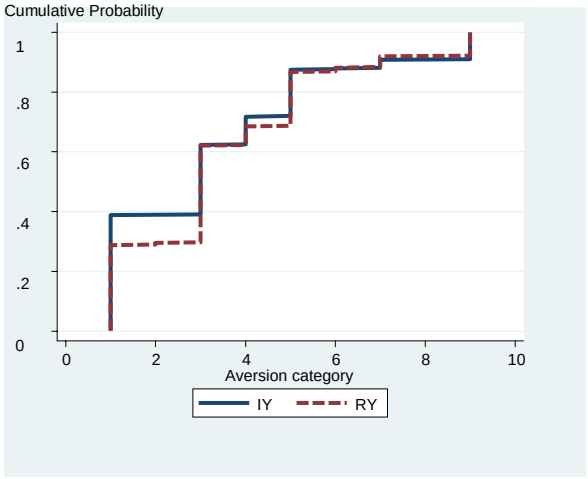
AVERSION LEVEL TO INEQUALITY/RISK IN HEALTH/INCOME (CUMULATIVE PROBABILITY DISTRIBUTIONS)

(a) INEQUALITY-RISK AVERSION IN HEALTH



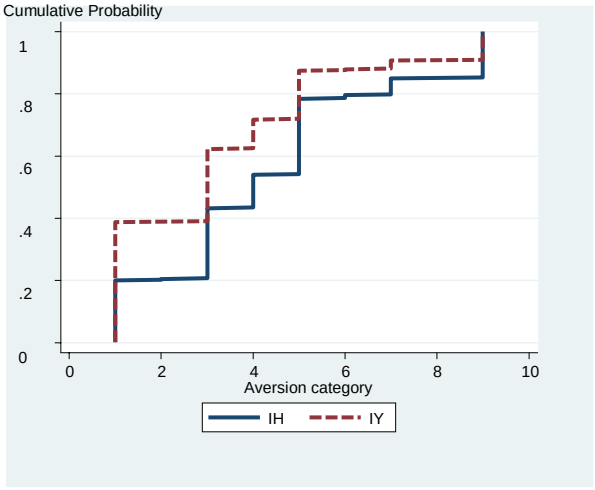
Wilcoxon sign rank test $p < 0.001$

(b) INEQUALITY- RISK AVERSION IN INCOME



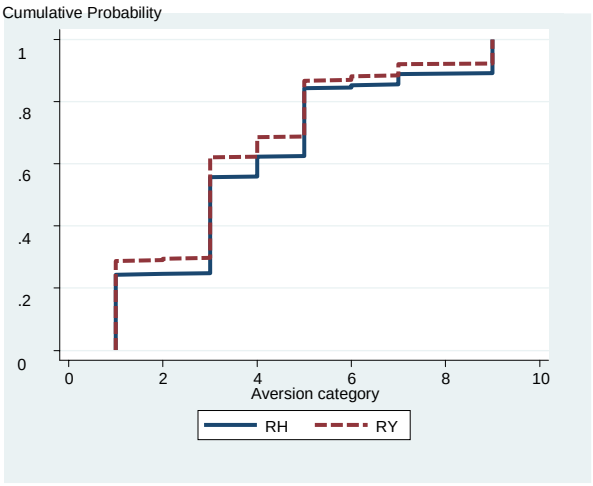
Wilcoxon sign rank test $p = 0.046$

(c) INEQUALITY AVERSION HEALTH-INCOME



Wilcoxon sign rank test $p < 0.001$

(d) RISK AVERSION HEALTH-INCOME



Wilcoxon sign rank test $p = 0.002$

The last two columns of Table 2 show the implied aversion parameters under constant relative and constant absolute aversion. For instance, the response pattern “ABBB” (i.e. the respondent selects scenario A for the first scenario pair, then B for the second pair onwards) implies the range $0 < r_R < 0.710$ for constant relative aversion, and $0 < r_A < 0.481$ for constant absolute aversion.

Table 3 gives the definitions and descriptive statistics of the covariates used in the regression analyses. Table 4 reports the results of the interval regressions for the question-based models. Firstly, the results show that there is a similar pattern across constant relative and constant absolute aversion for each question in terms of the sign and statistical significance of the variables. Secondly, eight variables were significant across different questions but none were consistently across four questions. Thirdly, gender, being unemployed or retired, having very good self-assessed health, and attitudes to free-riding and charitable giving were not significant in any of the models.

Table 3

DEFINITIONS OF COVARIATES AND DESCRIPTIVE STATISTICS

Variable	Definition	Mean (S.D.)
Female	Individual being a female (yes=1, no=0)	0.525
Age	Age of the individual	45.214 (17.648)
Primary	Individual has primary school education or less (yes=1, no=0)	0.160
Secondary	Individual has secondary education (yes=1, no=0)	0.238
University	Individual has a university degree (yes=1, no=0)	0.602
Employed	Individual being currently employed (yes=1, no=0)	0.648
Unemployed	Individual being currently unemployed (yes=1, no=0)	0.082
Student	Individual being currently studying (yes=1, no=0)	0.065
Housewife	Individual being currently housewife (yes=1, no=0)	0.053
Retired	Individual being retired (yes=1, no=0)	0.151
Health very good	Individual having very good health (yes=1, no=0)	0.273
Free rider charity	Individual agrees to statement “There is no need for me to donate to charity, because others already to it” (agree=1, disagree=0)	0.112
Free rider blood	Individual agrees to statement “There is no need for me to donate blood, because others already to it” (agree=1, disagree=0)	0.102
Selfsuff	Interviewer agrees to statement “The respondent did not needed help in the interview” (agree=1, disagree=0)	0.581

Table 4

INTERVAL REGRESSIONS FOR INEQUALITY / RISK AVERSION ESTIMATES IN HEALTH AND INCOME

	Inequalities in health (IH)		Risk in Health (RH)		Inequalities in Income (IY)		Risk in Income (RY)	
	CRA (c)	CAA (c)	CRA (c)	CAA (c)	CRA (c)	CAA (c)	CRA (c)	CAA (c)
Female	0.029	0.020	0.073	0.050	0.059	0.040	0.028	0.019
Age	-0.020	-0.013	-0.024(**)	-0.016 (**)	-0.002	-0.002	-0.001	-0.001
Age^2 /100	0.000	0.000	0.000(**)	0.000 (**)	-0.000	-0.000	0.000	0.000
Secondary (a)	-0.170(*)	-0.114(*)	0.061	0.042	0.003	0.002	-0.018	-0.012
University (a)	-0.225(**)	-0.152(**)	-0.007	-0.005	-0.215 (*)	-0.145 (*)	0.013	0.008
Unemployed (b)	-0.041	-0.027	-0.115	-0.077	0.154	0.104	-0.066	-0.045
Student (b)	-0.213(*)	-0.143(*)	-0.29 7(**)	-0.200 (**)	0.013	0.008	-0.083	-0.056
Housewife (b)	-0.054	-0.037	0.101	0.068	0.356	0.239	0.382 (*)	0.257 (*)
Retired (b)	-0.234	-0.158	-0.221	-0.149	-0.136	-0.092	0.084	0.056
Health V good	0.062	0.041	0.035	0.023	-0.076	-0.052	0.043	0.029
Free rider charity	0.200	0.135	-0.009	-0.006	0.217	0.146	0.174	0.118
Free rider blood	-0.073	-0.048	0.298 (**)	0.201 (**)	0.258 (*)	0.174 (*)	0.354 (**)	0.239 (*)
Selfsuff	-0.111 (*)	-0.075 (*)	-0.066	-0.045	-0.015	-0.010	-0.062	-0.042
Constant	0.767	0.517	0.696	0.470	0.604	0.409	0.330	0.224
	Log pseudo likelihood= -602.801 Wald chi2(13)= 26.86 Prob > chi2=0.0130	Log pseudo likelihood=-582.957 Wald chi2(13)= 27.00 Prob > chi2=0.0125	Log pseudo likelihood= -595.562 Wald chi2(13)= 30.08 Prob > chi2=0.0046	Log pseudo likelihood= -583.224 Wald chi2(13)= 30.31 Prob > chi2=0.0043	Log pseudo likelihood= -553.078 Wald chi2(13)=29.12 Prob > chi2=0.0063	Log pseudo likelihood= -537.446 Wald chi2(13)= 29.31 Prob > chi2=0.0059	Log pseudo likelihood= -566.193 Wald chi2(13)= 27.44 Prob > chi2=0.0108	Log pseudo likelihood= -522.771 Wald chi2(13)= 27.52 Prob > chi2=0.0106

(a) Baseline category: primary.

(b) Baseline category: employed.

(c) CRA: Constant relative aversion; CAA: Constant absolute aversion.

(**) p-value<0.05; * p-value<0.1.

These regression coefficients were used to predict a point estimate of the relative and absolute aversion parameters for each question, for each respondent, and Table 5 gives the summary statistics of these. Panel (a) is for the constant relative aversion parameters and the first four columns of panel (b) are for the constant absolute aversion parameters. All the means and medians were positive, indicating aversion. Across all four questions, based on the mean or the median, both parameters are ranked in the same order from IY the most averse, followed by RY, RH and with IH the least averse.

Table 5

SUMMARY STATISTICS FOR THE PREDICTED FROM INTERVAL REGRESSIONS

(a) Constant *relative* aversion parameters (r_R) by question

	r_R IH	r_R RH	r_R IY	r_R RY
Mean	0.124	0.256	0.477	0.356
SD	0.136	0.154	0.211	0.176
Maximum	0.508	0.820	1.117	0.981
75th percentiles	0.206	0.311	0.576	0.367
Median	0.105	0.230	0.466	0.300
25th percentiles	0.030	0.160	0.309	0.247
Minimum	-0.288	-0.149	0.022	0.122

(b) Constant *absolute* aversion parameters (r_A) by question, and the income-equivalent converter (M)

	r_A IH	r_A RH	r_A IY	r_A RY	Income-equiv.*	r_A (IHE)	r_A(RHE)
Mean	0.086	0.174	0.323	0.242	1.007	0.040	0.085
SD	0.092	0.104	0.142	0.118	0.146	0.044	0.052
Maximum	0.346	0.555	0.755	0.663	1.351	0.173	0.305
75th percentiles	0.140	0.212	0.390	0.249	1.122	0.068	0.104
Median	0.073	0.157	0.316	0.204	1.003	0.034	0.072
25th percentiles	0.023	0.110	0.209	0.168	0.903	0.010	0.054
Minimum	-0.192	-0.099	0.017	0.085	0.643	-0.096	-0.049

[*] Number of weeks of income equivalent to number of weeks of serious illness.

The fifth question elicited the income-equivalent converter between the health and income domains. The modal preference was to select scenario A throughout (27 for 100), followed by AABBBB (23 for 100) corresponding to a week of ill health being converted into a range from 1/2 to 3/4 weeks' income loss, while the median preference was AAABBB corresponding to a range of 3/4 to one week's income loss. Table 6 presents the coefficients from the interval regression for this question. Summary statistics of the converter for each individual predicted from this regression result, and the resulting income-equivalents (IHE and RHE) are summarised in the last three columns of Table 5(b). The column labelled "Income-equiv." indicates that the mean and median numbers of weeks of income loss equal in value to a week of health loss was roughly one. Predicted values of r_A for IHE and RHE were slightly lower than the corresponding predicted values of r_A for IH and RH (and therefore do not affect the relative ordering of the four aversion parameters).

Table 6

DETERMINANTS OF THE INCOME-EQUIVALENT CONVERTER

Variable	Coefficient
Female	0.150 (**)
Age	0.006
Age squared /100	-0.000
Secondary	-0.124
University	-0.054
Unemployed	-0.056
Student	-0.008
Housewife	-0.304 (**)
Retired	- 0.108
Health very good	-0.084
Free rider charity	-0.034
Free rider blood	0.037
Selfsuff	-0.170 (**)
Constant	1.021
	Log pseudo likelihood=-760.991 Wald chi2(13)=26.91 Prob > chi2=0.0128

(**) *p*-value <0.05.

Finally, Table 7 gives the parameter estimates for the question dummies from the random effects interval regressions based on combinations of questions. The question named first in the labels were used as the baseline so that, for example, the first column (IH vs RH) is for the combination of the inequality in health question (IH) and the risk in health question (RH), and the positive and statistically significant coefficient reported in the first row (0.119) indicates that, after controlling for the covariates (reported in Table 4), the relative risk aversion parameter for risk in the health domain is on average 0.119 points higher than for inequality. The third and fourth columns use IH and RH for relative aversion, and IHE and RHE for absolute aversion. As can be seen, all nine parameters estimated were statistically significant, and all the signs across the matching relative and absolute aversion coefficients were the same; in addition, all the models had significant likelihoods. Across the domains, both inequality aversion and risk aversion were stronger for income than for health. Within domains, risk aversion was stronger than inequality aversion within health, but inequality aversion was stronger than risk aversion in income. As a consistency check of the income equivalent converters, the fifth column shows the result of IHE vs RHE, which is consistent (equal sign and significance, although much smaller in magnitude) with IH vs RH under constant absolute aversion. Full regression results are available on request.

Table 7

RESULTS OF THE RANDOM EFFECTS INTERVAL REGRESSIONS (PARAMETER ESTIMATES FOR THE QUESTION DUMMIES ONLY)

	IH vs RH	IY vs RY	IH(E)[a] vs IY	RH(E)[b] vs RY	IHE vs RHE
CRA	0.119(**) Log lik.=- 1146.011 Wald chi2(14)=35.15 Prob > chi2= 0.0014	-0.085(**) Log lik.=-1074.847 Wald chi2(14)=30.45 Prob > chi2=0.0066	0.297(**) Log lik.=-1126.956 Wald chi2(14)=84.04 Prob > chi2=0.0000	0.087(**) Log lik.=-1075.780 Wald chi2(14)=37.26 Prob > chi2=0.0007	n/a
CAA	0.080(**) Log lik.=- 1114.108 Wald chi2(14)=35.32 Prob > chi2= 0.0013	-0.058(**) Log lik.=-1045.604 Wald chi2(14)=30.63 Prob > chi2=0.0062	0.220(**) Log lik.=- 551.889 Wald chi2(14)=106.24 Prob > chi2=0.0000	0.110(**) Log lik.=-1095.484 Wald chi2(14)=72.93 Prob > chi2=0.0000	0.039(**) Log lik.=-1058.01 Wald chi2(14)=34.65 Prob > chi2=0.0017

Controlled for covariates shown in Table 3.

(a) IH for constant relative aversion; IHE for constant absolute aversión.

(b) RH for constant absolute aversion; RHE for constant absolute aversión.

(**) *p*-value<0.05; * *p*-value<0.1.

4. DISCUSSION

In this study we find evidence suggesting that preferences regarding inequality and risk aversion are not the same *within* the health or the income context, nor across the two contexts. Inequality/risk averse preferences have the greatest support followed by inequality/risk seeking preferences, with inequality/risk neutral preferences coming last. This ordering is not affected by the choice between constant relative and constant absolute aversion.

This paper is based on an interview survey of a representative sample of the general public in Spain. All questions were asked from a decision maker's perspective regarding a hypothetical population of 1000 individuals, and were interpreted to represent a societal preference concerning social welfare (as opposed to an individual preference concerning own utility). All questions involved losses in individual health and/or household income for a limited duration (two to six weeks), and respondents were instructed to assume losses in health and income occurred independently of each other.

When the cumulative distributions are compared building on the ordinal nature of the nine aversion categories, all four comparisons emerge with significant differences (although the sign rank test for IY vs RY is only marginally significant). The fifth question on the income-equivalent converter was designed to elicit a societal MRS between severe illness and income loss. It was motivated by the concern that people may contrast the difference between scenario A and scenario B in the four main questions in terms of the number of weeks, rather than in terms of relative proportions of weeks. The answers on this question had a bimodal distribution, and resulted with a significant association with whether the respondent needed the interviewer's help (assessed by the interviewer for the whole interview), suggesting that it was possibly the most difficult of all the questions asked. Although the survey was subject to a small scale pilot study to check respondent comprehension and to fine tune the presentation, there was no extensive piloting to select the range of implied converter values to present. Regarding the two social welfare function specifications, the survey does not provide any information towards choosing between the two. Furthermore, in practice, both approaches have resulted in similar findings. Nevertheless, qualitative work to explore how respondents process these five questions would be of interest.

While all the regression models used in the study had significant likelihood ratios, only a handful of coefficients were significant and each had small magnitudes. This implies that the predicted values of the aversion parameters and the income-equivalent converter were in effect largely driven by the constant term (none of which were significant). Given the way the questions were asked, predicting point estimates through interval regressions was an obvious approach. However, the skewed distribution of the responses violates a necessary assumption for interval regressions, and furthermore, this has resulted in very narrow distributions of the parameters. The latter can be addressed by including the observed interval data in the prediction so that the point estimates of the aversion parameter or the income-equivalent converter are predicted conditional on the actual categorical response given by the individual respondent. This results in wider variance but the means remain largely unaffected, and thus the overall qualitative results remain robust.

When people were asked in a previous study by Keller and Sarin (1988) to choose on behalf of others between two health scenarios of equal expected value, where one scenario (I) involved ex post inequality but no uncertainty in total losses, and the other scenario (R) involved no ex post inequality but an uncertainty in total losses, respondents preferred R over I. If so, we may expect a stronger aversion to inequality than to risk. However, the results here disagree. In health, they suggest weaker aversion to inequality than to risk (and in income, only marginally stronger aversion to inequality than to risk). One possibility is framing. As in Keller and Sarin, where respondents are faced with I and R directly, the ex post inequality element may be more prominent than the uncertainty in total losses (and especially so, if the difference is between life and death as in their study). On the other hand, in this study, respondents compared I against a reference (with no uncertainty or inequality); and then compared R against the same reference. This presentation may have helped respondents to pick up the key features of each scenario.

Another finding to note is the stronger inequality (and risk) aversion in income than in health, which seems to disagree with Anand (2002). However, it should also be noted that this paper does not test directly whether Anand's argument has empirical support. Firstly, while Anand does not distinguish between gains and losses, our survey was entirely framed in terms of losses. Secondly, while Anand's

argument refers to mortality and permanent disability, the measure of health used in our study was temporal illness. Thirdly, the interviews were conducted in June and July 2012, and it is possible that the on-going crisis affecting the Spanish economy may have led individuals to become relatively more sensitive to financial losses than to health losses; however, we cannot test for this as we have no qualitative information on the motivation behind the responses. Fourthly, respondents may have thought that whilst inequality in income is largely socioeconomically determined and transmitted to subsequent generations, inequality in health is largely due to one's choice and behaviour. Any of these points may have led to our respondents expressing stronger inequality (and risk) aversion in income compared to health.

These results should be interpreted with care and we discuss six points. First, in this study we decided to consider scenarios in losses rather than gains. However, there is evidence that suggests people feel losses more intensely than gains of the same value (Tversky and Kahneman 1991). Whether this may have affected the health and income contexts differently is something that is not known.

Second, on the other hand, with respect to previous studies that compared inequalities in lifetime health, our study has considered losses at a relatively small scale. This may have resulted in the failure to detect aversion in inequality and/or risk which would have been picked up if larger losses were used. If so, discrepancy observed between the questions may be underrepresented. Another issue relates to what is understood by "severe ill health". In the questionnaire design it was decided against naming some particular illness such as the flu in order to avoid conditioning responses in one or other direction. While the heterogeneity in how people interpreted "severe ill health" may have affected the answers in non-random ways, as long as respondents had the same health problem in mind across the whole exercise, this should not affect the paired analyses.

Third, in the questions used, the losses in health happen to individuals while the losses in income happen to individuals clustered in households. Although the questions were designed so that the number of individuals affected is always matched between the health and the income questions, and the income questions stated that all households consist of four individuals, this complete correlation between the context (health vs income) and the parties in the scenarios (individuals vs households) may have had an effect on the responses. The extent of possible bias introduced by this cannot be examined in this study.

Fourth, we have assumed that income and health are independent and additive. While this is unlikely to hold globally, since the numbers of weeks of loss used in the income-equivalent question are in a similar range to those used in the four main questions, it can provide a reasonable local approximation. The same assumption also means that the questions deal with "pure" inequalities, not health inequalities caused by (or correlated with) income inequalities; and vice versa. Lay members of the public may have theories about the relationship between income and health inequalities, and whether the respondents kept income and health separate in responding to our questions is something that has not been tested. On the other hand, the short duration of the loss in health may have diluted the special, fundamental status of health as a dimension of wellbeing.

Fifth, the questionnaire deliberately had an even number of pairs of scenarios, so that the inequality/risk neutral (or indeed any) scenario did not appear in the middle. This scenario structure could have biased the results in favour of inequality/risk seeking options. However, there is no reason to think that this potential bias had different effects across the four questions.

Sixth, the questionnaire has two versions, both covering the same four questions: in one version health questions are asked first, whilst in the other version the income questions are asked first. The two versions did not significantly affect the results of IH, RH and RY but results of IY were affected. The pooled analysis corrects for biases arising from the ordering of the topics. On the other hand, the sequence in which the scenarios are presented may have a few implications. Once a respondent starting from alternative A switched to choosing B, the subsequent scenarios were not asked. While this was to avoid the interview becoming too repetitive, it does mean that there is no opportunity to check whether the responses are rational (viz. do not switch back from B to A in the next pair). Furthermore, this practice may have induced the respondent to switch to B earlier simply to move on. However, if such a bias was present, it is likely to affect the later questions than the earlier ones, and picked up through the comparison of the two questionnaire versions. One final potential bias has the opposite effect: titration questions may result in respondents delaying the switching point compared to

the same set of scenario pairs being presented in a random order. However, if all four questions were affected similarly, then it should not affect the results of this paper.

5. CONCLUSION

This paper has compared across four kinds of aversion in societal preferences: inequality aversion in health, inequality aversion in income, risk aversion in health, and risk aversion in income. They were explored through face to face interviews of members of the general public using hypothetical scenarios involving losses in either health or income. The results implied that the four distributional preferences were statistically significantly different from each other, with inequality aversion in household income the strongest, followed by risk aversion in household income, then risk aversion in individual health, with inequality aversion in individual health coming last.

APPENDICES

APPENDIX 1: Example of questionnaire wording (original in Spanish)

Introduction to IH and RH. In the next questions, imagine a community of 1,000 individuals. We are going to talk about the health of this community in the following year: some individuals in the community will be healthy, others will be seriously ill for two weeks, others will be seriously ill for three weeks, others for four weeks, etc. We want you to think how to share those weeks of illness across the individuals of the community.

You are not one of the members of this community, but please imagine that *your opinion will be taken into account by the public authorities* who have to make a decision for them. There are no right or wrong answers.

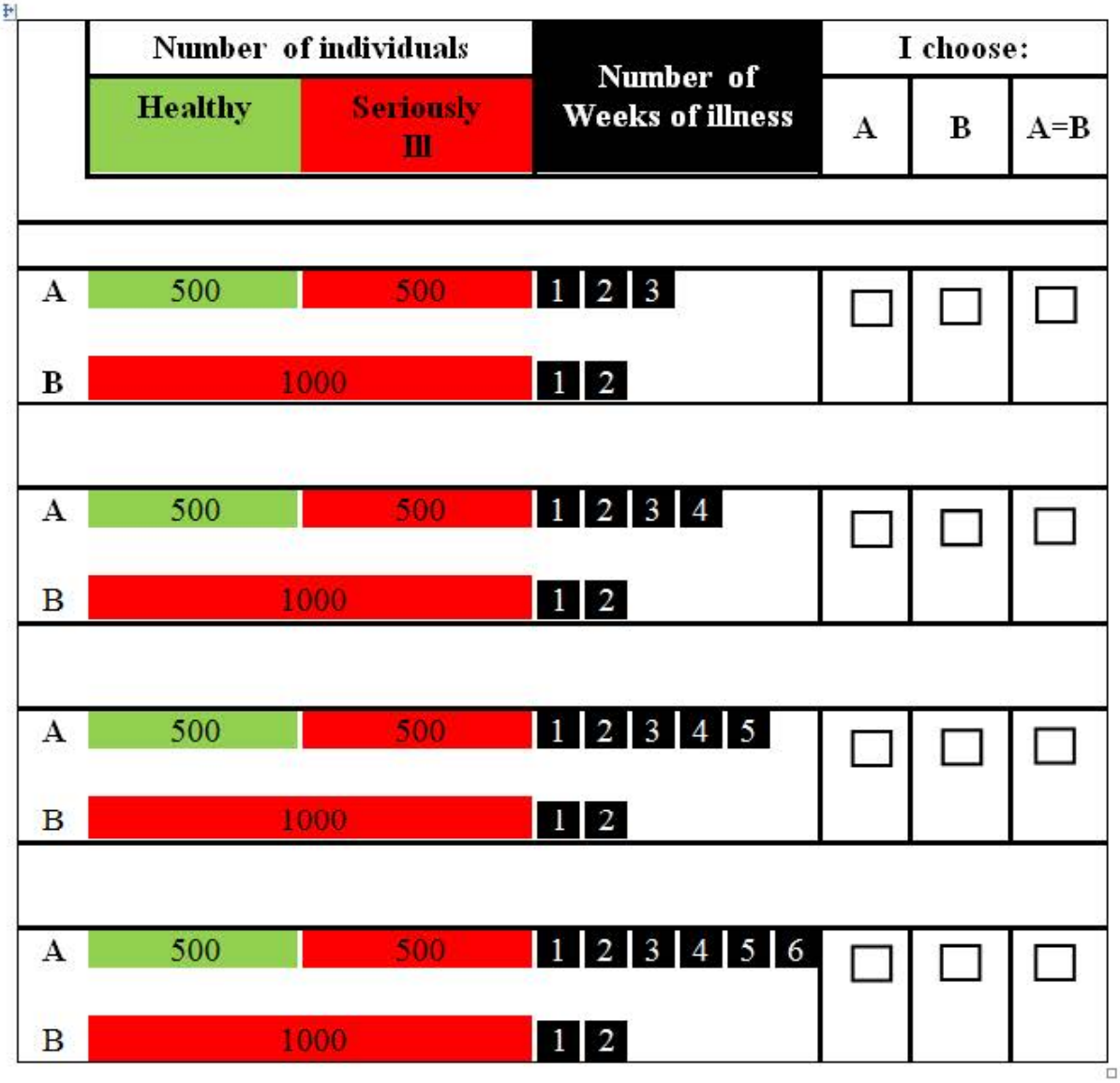
All the weeks with illness happen at random: i.e. on different and separate weeks. On different weeks means there will be no single week when a substantial proportion of the workforce is off sick at once. On separate weeks means they are non-consecutive. After this illness the individual recovers completely (there are no after-effects). There are no other illnesses. There is nothing individuals can do to change these outcomes.

IH. For each of the following four scenarios, we are going to show you two alternatives (A and B) between which we ask you to choose. Both alternatives A and B are feasible and would cost the same to society.

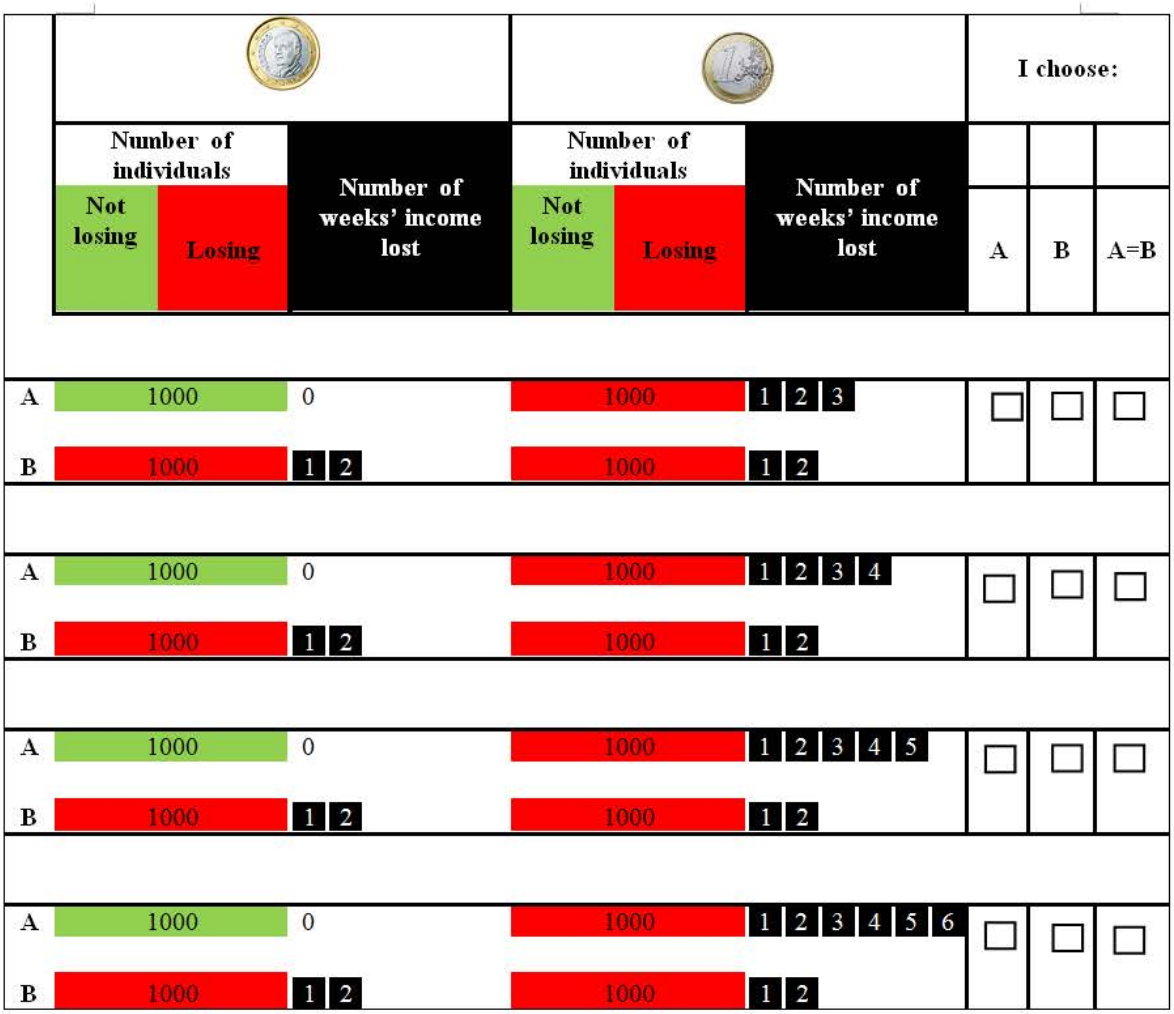
Outcome of Alternative (A): one half (500 individuals) will not be ill (i.e. they will be healthy) and the other half (500 individuals) will be seriously ill for 3 weeks.

Outcome of Alternative (B): everybody will be seriously ill for 2 weeks.

APPENDIX 2: Example visual aid for IH



APPENDIX 3: Example visual aid for RY



APPENDIX 4: Example visual aid for monetary value of health

Now, we are going to talk about the health and the income of this community of 1000 individuals (that is, 250 households with 4 individuals each). We want you to think about how to distribute the number of weeks of *illness* and the number of *income lost* among the individuals of the community. *You are not one of the members of this community*, but please imagine that your opinion will be taken into account by the public authorities who have to make a decision for them. There are no right or wrong answers. THE WEEKS OF ILLNESS DO NOT AFFECT THE INDIVIDUALS'WEEKLY INCOME, THAT IS, INCOME AND ILLNESS ARE INDEPENDENT. For each of the following six scenarios, we are going to show you two alternatives (A or B) between which we ask you to choose. Both alternatives A and B are feasible and would cost the same to society.

Outcome of Alternative (A): all individuals will be seriously ill for 1 week and all households will lose 6 weeks income.

Outcome of Alternative (B): all individuals will be seriously ill for 5 weeks and all households will lose 5 weeks income.

	HEALTH		INCOME		I choose :		
	Number of indiviudals Seriously ill	Number of weeks of illness	Number of individuals Losing income	Number of weeks income lost	A	B	A=B
A	1000	1	1000	1 2 3 4 5 6			
B	1000	1 2 3 4 5	1000	1 2 3 4 5			
A	1000	1	1000	1 2 3 4 5 6			
B	1000	1 2 3 4 5	1000	1 2 3 4			
A	1000	1	1000	1 2 3 4 5 6			
B	1000	1 2 3 4 5	1000	1 2 3			
A	1000	1	1000	1 2 3 4 5 6			
B	1000	1 2 3 4 5	1000	1 2			
A	1000	1	1000	1 2 3 4 5 6			
B	1000	1 2 3 4 5	1000	1			
A	1000	1	1000	1 2 3 4 5 6			
B	1000	1 2 3 4 5	1000	0			

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