The Tyranny Puzzle in Welfare Economics: An empirical investigation

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Abstract

We address a puzzle in welfare economics - the possibility that rational people may be simultaneously against two apparently conflicting forms of "tyranny". In fact the two types of tyranny can be reconciled but at the possible cost of conflict with other standard welfare principles. We examine whether such conflicts do arise using a questionnaire-experimental study. Our study shows that both tyrannies are rejected by a majority of the participants, and in many cases also pose a practical problem in moral reasoning.

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1 Introduction

This paper is about a dilemma in welfare economics that should, perhaps, be better recognised. Recently Fleurbaey and Tungodden (2010) showed that there is an apparent conflict between welfare criteria that are designed to avoid different types of "tyranny" in social choice. One type of tyranny is where social choices can be driven entirely by weight of numbers, irrespective of the interests of some specially disadvantaged member of society; the other type of tyranny is where social choices are driven entirely by the interests of one person, albeit a very needy person. The apparent conflict can be resolved, but the resolution may involve a further conflict with other fundamental welfare principles that are almost always taken as given in conventional welfare economics. The word "may" is important here because whether there is really a conflict or not depends on the precise formulation of the issues and the precise context in which the problem is considered: in particular this is a case where the size of the population under consideration really matters.

It would be interesting to know whether the underlying issue is more than just a theoretical curiosity by investigating the way people view the problem of choice between distributions. Is there evidence of a dilemma? Do they lean in the direction of one type of "tyranny" or the other? Are they concerned about the "standard" welfare principles that are taken for granted in conventional welfare economics? We pursue these questions using a specially designed questionnaire study of opinions.

The paper is organised as follows. Section 2 outlines some of the theory and explains the nature of the dilemma that lies at the heart of this paper. Sections 3 and 4 set out our approach to an empirical investigation of the problem and the main results. Section 5 examines the role of respondents' background in accounting for the pattern of answers to the questionnaire study. Section 6 concludes.

2 Theoretical background

Consider the following four welfare principles that appear to be intuitively reasonable.

- *Avoiding mob tyranny.* Such a tyranny – also known as the "tyranny of aggregation" – means a situation where weight of numbers can be decisive in social-welfare judgments even in cases where the (many) gainers gain very little and the (few) losers lose a lot.

- *Avoiding individual tyranny.* This tyranny – also known as the "tyranny of non-aggregation" – means a situation where the well-being of one person is decisive even in cases where there are many other persons in society.

- *Respect for progressive transfers.* In its strict form this means that a transfer from a poorer to a richer member of society produces a welfare decrease; in its weaker form it requires that such a transfer should not increase welfare. (Dalton 1920, Pigou 1912).

- *Irrelevance of replication.* Social-welfare comparisons of income distributions are unaffected by "scaling up" the population.

It is clear that many commonly used welfare criteria are consistent with some, but not all, of these principles. We can show this using a couple of examples in an n-person society. Let the utility of person i be given by u_i (a real number), $i = 1, 2, ..., n$, label the persons such that $u_1 \leq u_2 \leq ... \leq u_n$ and write social welfare in this society as $W(\mathbf{u})$ where $\mathbf{u} := (u_1, u_2, ..., u_n)$. Define $\mathbf{u}(\varepsilon)$ as the vector derived from $\mathbf{u}$ by subtracting an amount ε from the component $i = i_{\text{from}}$ and adding ε to component $i = i_{\text{to}}$; the change $\mathbf{u} \to \mathbf{u}(\varepsilon)$ represents a transfer of ε from one individual (i_{from}) to another (i_{to}). Also define $\mathbf{u}[m]$ as the mn-dimensional vector derived from $\mathbf{u}$ by replicating it $m - 1$ times; this is the formal representation of "scaling up" the population.

Example 1 *Suppose the social-welfare function is of the form*

$$W(\mathbf{u}) = \sum_{i=1}^{n} \phi(u_i) \tag{1}$$

where ϕ is an increasing function.

- *Suppose person j loses an amount δ of utility and everyone else gains Δ: then the change in social welfare is approximately*

$$-\phi'(u_j)\,\delta + \sum_{\substack{i=1 \\ i \neq j}}^{n} \phi'(u_i)\,\Delta \tag{2}$$

where ϕ' denotes the first derivative of ϕ. Person j's utility loss is not decisive though, because if the gain to the others is large enough then (2) could turn out positive rather than negative – there is no individual tyranny.

- *Furthermore, it is well known that, if ϕ is concave, then*

$$W(\mathbf{u}) \geq W(\mathbf{u}(\varepsilon)) \text{ if } \varepsilon > 0 \text{ and } i_{\text{from}} < i_{\text{to}} \tag{3}$$

with strict inequality if ϕ is strictly concave so that (1) respects the principle of progressive transfers.

- *Clearly also $W(\mathbf{u}[m]) = mW(\mathbf{u})$ so that, for any two n-vectors $\mathbf{u}$ and $\mathbf{u}'$:*

$$W(\mathbf{u}) \geq W(\mathbf{u}') \text{ implies } W(\mathbf{u}[m]) \geq W(\mathbf{u}'[m]) \tag{4}$$

which means that (1) satisfies irrelevance of replication.

- *So the last three of the above four "intuitively reasonable" principles are satisfied. But the remaining principle is not satisfied. Suppose the distribution $\mathbf{u}$ is such that*

$$u_1 < u_2 = u_3 = ... = u_n \tag{5}$$

and imagine a situation where poor person 1 loses δ while everyone else gains Δ; expression (2) now becomes

$$-\phi'(u_1)\delta + [n-1]\phi'(u_2)\Delta \tag{6}$$

Even though ϕ' is strictly decreasing and even if δ is a big number while Δ is small, (6) could turn out positive if n were large enough. This is exactly the phenomenon of mob tyranny.

Example 2 *Suppose instead the social-welfare function has the "maxi-min" form*

$$W(\mathbf{u}) = u_1. \tag{7}$$

Again three out of the four principles hold for W as defined in (7). First, (3) holds, with strict inequality if $i_{\text{from}} = 1$. Also $W(\mathbf{u}[m]) = W(\mathbf{u})$ so that (4) trivially holds. Furthermore, because W respects only the utility of the poorest person, the welfare change expressions corresponding to (2) and (6) equal $-\delta$; there is no mob tyranny (it does not matter how large n is) but there is individual tyranny (it does not matter how large Δ is).

But, from just these two examples, a worrying question arises. Together the functions W given in (1) and (7) cover a very large proportion of commonly used welfare criteria; so is it the case that we always have to put up with one or other tyranny in a social-welfare function?

The short answer to this question is "no," but the longer answer to it is particularly interesting.[1] The problem is essentially to do with the implied weighting of individuals in the computation of social welfare. Clearly the social-welfare functions in the two examples are special cases of

$$W(\mathbf{u}) = \lambda_1 \phi(u_1) + \lambda_2 \phi(u_2) + ... + \lambda_n \phi(u_n), \tag{8}$$

where the λ_i are a set of "positional weights": (1) assigns an equal weight to everyone, whatever their position in the income distribution; by contrast (7) assigns a positive weight to the poorest ($\lambda_1 > 0$) and zero weight to everyone else. But, perhaps one might be able to resolve the problem of the two tyrannies by introducing a set of weights λ_i that is strictly decreasing in i, from poorest to richest. This can indeed be done, as in the following example; but the example also illustrates a further problem that arises in cases where both tyrannies are avoided.

Example 3 *Suppose social welfare is given by*

$$W(\mathbf{u}) = \sum_{i=1}^{n} \lambda^{i-1} u_i \tag{9}$$

where $\lambda < 1$.

- *If person j loses an amount δ of utility and everyone else gains Δ then the change in social welfare is*

$$-\delta \lambda^{j-1} + \sum_{\substack{i=1 \\ i \neq j}}^{n} \lambda^{i-1} \Delta. \tag{10}$$

  Person j's utility loss is not decisive because, if δ is not too large, the evaluation of the gains of the other $n-1$ people may be sufficiently large to cause (10) to be positive. Individual tyranny is avoided in the case of this social-welfare function.

[1] Avoiding individual tyranny requires a principle such as *minimal aggregation*: for every person there is some small utility loss that can be taken as acceptable if all the other members of society have a large enough utility gain. Likewise, avoiding mob tyranny requires a principle such as *minimal non-aggregation*: if a worst-off person is sufficiently badly-off and gains enough, there is a small loss that is tolerable for all the best-off people, no matter how many of these better of people there are. These aggregation and non-aggregation principles are fully discussed in Fleurbaey and Tungodden (2010) and Fleurbaey et al. (2009).

- *Furthermore if* $j = 1$ *and* $u_1 < u_2 = u_3 = ... = u_n$ *then (10) becomes*

$$-\delta + \frac{\lambda - \lambda^n}{1 - \lambda}\Delta \tag{11}$$

and it is clear that, if δ *is sufficiently large, then (11) could be negative, no matter how large* n *is: the large single loss outweighs the gains of the many. Mob tyranny is also avoided.*

- *The social-welfare function in (9) also respects the principle of progressive transfers. To see this note that* $W(\mathbf{u}) - W(\mathbf{u}(\varepsilon))$ *is proportional to* $\varepsilon[1 - \lambda^r]$ *where* $r := i_{\text{from}} - i_{\text{to}}$*; given* $\varepsilon > 0$*,* $\lambda < 1$ *and* $i_{\text{to}} > i_{\text{from}}$ *it is clear that once again* $W(\mathbf{u}) > W(\mathbf{u}(\varepsilon))$*.*

- *However the fourth principle – irrelevance of replication – is violated by the social-welfare function in (9).*[2] *Let* $\mathbf{u}$ *be given by (5) and again suppose that* $\mathbf{u}'$ *is formed from* $\mathbf{u}$ *thus*

$$\left(u'_1, u'_2, u'_3, ..., u'_n\right) = (u_1 - \delta, u_2 + \Delta, u_3 + \Delta, ..., u_n + \Delta). \tag{12}$$

Then $W(\mathbf{u}') - W(\mathbf{u})$ *is given by (11). Now replicate the two vectors, so that there are* 2 *poor people who each lose* δ *and* $2n - 2$ *rich people who each gain* Δ*. The change in social welfare* $W(\mathbf{u}'[2]) - W(\mathbf{u}[2])$ *is given by*

$$-\delta - \lambda\delta + \frac{\lambda^2 - \lambda^{2n}}{1 - \lambda}\Delta. \tag{13}$$

If $\lambda, \Delta, \delta, n$ *are such that*

$$\frac{\lambda^2 - \lambda^{2n}}{1 - \lambda^2} < \frac{\delta}{\Delta} < \frac{1 - \lambda^n}{1 - \lambda}, \tag{14}$$

then expression (11) is positive while expression (13) is negative. Hence it is possible to have both $W(\mathbf{u}') > W(\mathbf{u})$ *and* $W(\mathbf{u}'[2]) < W(\mathbf{u}[2])$*.*

Two further observations. First it is clear that as n increases indefinitely, the bounds appearing in (14) move apart, as their difference equals $(1 - \lambda^n)(\lambda - \lambda^n) / \left(1 - \lambda^2\right)$: so the larger the population, the easier the conditions for violating the replication principle. Second it is possible to find a social-welfare criterion that avoids both individual tyranny and mob tyranny

[2] See also Capéau and Ooghe (2007).

and that satisfies the population-replication principle, but this would then violate the principle of progressive transfers.[3]

In sum, it is possible to find a criterion for social choice that avoids either form of tyranny, but in doing so one may violate other fundamental principles such as the respect for progressive transfers and the irrelevance of replication. We can only be sure of reconciling three out of the four intuitive principles that we mentioned in the introduction to this section.

The theoretical formulation of the problem, however, requires that the population size is unbounded. When the population size is bounded, the problem takes a milder form. Suppose for instance that the population cannot exceed ten individuals. Then the risk of mob tyranny when $u_1 < u_2 = u_3 = ... = u_n$ is easily avoided with the social welfare function (1) by making ϕ sufficiently concave – that is, by adopting a sufficient aversion to inequality – so as to make

$$-\phi'(u_1)\,\delta + 9\phi'(u_2)\,\Delta < 0.$$

When n reaches astronomical magnitudes, a much stronger aversion to inequality is needed to guarantee that

$$-\phi'(u_1)\,\delta + [n-1]\,\phi'(u_2)\,\Delta < 0.$$

The problem is that this inequality not only means that individual 1 losing δ while *all the others* gain Δ is considered undesirable, but also that individual 1 losing $\delta/(n-1)$ while individual 2 *alone* gains Δ is also rejected. When n is very large, this implies individual tyranny.

The tension between avoiding mob tyranny and avoiding individual tyranny therefore depends on the possible size of the population and on the degree of inequality aversion that one is willing to adopt, or, in other words, on how afraid of individual tyranny one is. The greater the inequality aversion (the less one is afraid of individual tyranny), the greater the size of the population that is needed to make mob tyranny occur. One may therefore ask if, with the typical degree of inequality aversion that one encounters in the population, the population size that is needed to reveal the tension is realistic or astronomical. In the latter case, the problem can be considered mostly theoretical. In the former case, decision-makers and practitioners should seriously worry about it.

[3] This is shown in Fleurbaey and Tungodden (2010) who use as an example the case where one makes the choice between $\mathbf{u}$ and $\mathbf{u}'$ on the basis of a leximin comparison of $(\text{int}u_1, \text{int}u_2, ..., \text{int}u_n)$ and $(\text{int}u'_1, \text{int}u'_2, ..., \text{int}u'_n)$ where int$u$ means the smallest integer greater than or equal to u.

3 The approach

Is the problem outlined in section 2 anything more than a neat theoretical conundrum? To establish whether the two tyrannies pose a dilemma in practice we used the established technique of elicitation by means of questionnaire.[4] The questionnaire combines verbal and numerical questions, contains questions in both closed and open form, and allows for respondents' comments.

3.1 Questionnaire summary

The main part of the questionnaire consists of four scenarios, each of which concentrates on one specific principle. The questionnaire itself is reproduced in the Appendix; here is a sketch of the content and the structure of possible responses:

Scenario 1 (Mob tyranny) Suppose one poor person benefits from an income increase of £G while all the rich,[5] no matter how many there are, suffer an income reduction of £1. If G were large enough would this be a good idea?

- A *Agree*
  - then specify the threshold value of G
- B *Disagree*

Scenario 2 (Individual tyranny) Suppose one poor person suffers from an income cut of £1 while M rich people benefit from an increase of £100. If M were large enough would this be a good idea?

- A *Agree*
  - then specify the threshold value of M
- B *Disagree*

Scenario 3 (Principle of progressive transfers) Suppose a small amount of income ε is transferred from a rich person to a much poorer person. Would this be a good idea?

[4] The method is set out in detail in Amiel and Cowell (1999). See also Gaertner and Schwettmann (2007) and the references therein for a recent application focusing on equity judgments that give priority to the worst-off.

[5] In the questionnaire we defined rich and poor as people with incomes of £50,000 and £10,000, respectively.

- A *Agree*
- B *Disagree*

Scenario 4 (Replication) Suppose n_1 people with income y_1 experience an income increase of Δ and n_2 people with income y_2 experience an income decrease of δ and that this change in income distribution is considered a good idea. Would it also be a good idea if the numbers n_1 and n_2 were replaced by mn_1 and mn_2?

- A *Agree*
- B *Disagree*

On each scenario the respondents were invited to provide comments to elucidate their answers if they wished to do so. The order in which scenarios 1 and 2 were presented was reversed in about half of the questionnaires.

There then follow some questions on personal characteristics and background; details on these are to be found in the discussion of the results in section 5.

3.2 Sample

The questionnaire was run on a sample of 642 student respondents in three groups. Two groups consisted of first-year and second-year students from the Norwegian School of Economics and Business Administration (labelled NHH1 and NHH2 in the tables below); the third group was from the London School of Economics and consisted of second-year undergraduates taking a mathematically oriented microeconomics course.

The questionnaire was carried out under supervision during class time; respondents were informed that the questionnaire was anonymous and were requested not to interact with each other when filling in their responses.

3.3 Responses

We begin with an impression of the type of distributional judgments made by those in our sample, based on an overview of the pattern of responses.

The principal responses to the first two scenarios – on the two tyrannies – can be classified according to four types as in Table 1 where the interpretation is as follows:

- The "anti-anti" respondents (in the AA category) are against both individual tyranny and mob tyranny. Indeed the comments provided

		Scenario 2	
		A	*B*
Scenario	*A*	Anti-Anti	Maximin
1	*B*	Aggregative	Pro-Pro

Table 1: Types of response

by these respondents reveal their concern that the interests of the poor person be protected[6] but also concern that small changes for the poor do not dominate the wider interests of society.[7]

- The AB category consists of those whose responses are consistent with the "maxi-min" principle (7); these respondents are against mob tyranny.
- The BA category consists of those whose responses are consistent with the aggregative approach implicit in welfare principles such as (1); these respondents are against individual tyranny.
- BB-type responses might be given by libertarians or by those who were confused about the underlying issues.

The proportions of respondents of each type for the three subsamples are given in Table 2. Although there is a relatively lower proportion of LSE respondents in category AB and a relatively higher proportion in category BB, the differences between the subsamples are not great. Adding the proportions in columns AA and AB we can see that a majority rejects mob tyranny in scenario 1; however, adding the proportions in columns AA and BA we can also see that a majority rejects individual tyranny in scenario 2!

[6] "The person suffering a £1 loss is already well off, so won't be affected much, but gains for the poorer one will increase life standard significantly." "Any increase in income for the person with £10,000 would be a good thing in my opinion, however it would need an extra £10,000 to bring their living standard to decent." "£1 is a small proportion of £50,000. This would not reduce living standards significantly, £10,000 would help the single person to have decent living standards." "The ones who earn £50,000 have enough money, and even the slightest increase of the ones who earn £10,000 is for the good." "The marginal utility for each pound is larger for a person with low income than for a person with a high income. £1 reduction out of £50,000 doesn't change so much for the person with a high living standard."

[7] "If 100 people get an increase in income of £100, it equals £10,000. A reduction of £1 is not that heavy a loss, from my view." "£1 is little, and if the £100 the rich ones gain can contribute to work places and a better economy, it is worth it."

	N	Type AA	Type AB	Type BA	Type BB
LSE	118	33.1%	23.7%	17.8%	25.4%
NHH1	225	33.3%	30.7%	20.0%	16.0%
NHH2	299	32.8%	30.4%	18.1%	18.7%
All	*642*	*33.0%*	*29.3%*	*18.7%*	*19.0%*

Table 2: Distribution of Responses to Scenarios 1 and 2 by type

The responses to scenarios 3 and 4 are summarised in Table 3 which shows the proportion of persons who responded A on scenario 3 (respect for progressive transfers) and the proportion who responded A on scenario 4 (irrelevance of replication).[8] It is clear that there is not much difference in the pattern of responses across the different subsamples: about 50% respond in accordance with the principle of progressive transfers;[9] the proportion of the NHH2 sample that consider replication to be irrelevant is lower (21%) than for either of the other two subsamples (around 31%).[10] The proportion of the samples (about 40%) that reject *both* principles may seem surprisingly high. However, the comments of the respondents in this category reveal that this heterodox position was often based on some careful reasoning; the B response on scenario 3 was justified on the grounds of fairness,[11] the intrinsic rights of individuals[12], speculation about other background issues not specified in the scenario[13] or wider issues of efficiency;[14] the B response

[8] Of the 642 persons in total 9 did not respond to Scenario 3 and 25 did not respond to Scenario 4.

[9] Sum the "Progressive Transfers and Replication" and "Progressive Transfers only" columns to see this

[10] Sum the "Progressive Transfers and Replication" and "Replication only" columns to see this

[11] "It is not fair for the person with £50,000" [and many similar comments]. "I don't think one person should have reduced income to increase another persons income if he doesn't wish this himself." "The tax system does more than this already".

[12] "There is a reason why some persons have an income of £50,000 so they should be able to keep it for themselves." "One's income should correspond to his contribution."

[13] "Depends of level of experience, educational background, skills, if reduction is fairly high the person that is used to the well-off lifestyle may get troubles with his economics." "Depends on how an individual has earned his income." "It depends on their situation, health, family, etc."

[14] "There will be no incentives to better if everyone is equal without a reason." "Simply a redistribution of income: not the creation of wealth. Removes the incentives to earn £50K." "If you end up giving it away i.e. you can be subsistence, not work hard and get by well enough." "A redistribution of income can harm economy if the low income person is not as skilled at investing as the high income person."

on scenario 4 was justified on the basis of concern for absolute numbers of the poor.[15] However these heterodox arguments do not provide a "solution:" even within a framework respecting all these concerns, the basic puzzle would remain.

	N	Progressive Transfers and Replication	Progressive Transfers only	Replication only	neither
LSE	118	18.6%	28.8%	11.9%	40.7%
NHH1	225	19.6%	28.0%	12.0%	40.4%
NHH2	299	11.7%	39.5%	9.7%	39.1%
All	*642*	*15.7%*	*33.5%*	*10.9%*	*39.9%*

Table 3: Distribution of Responses to Scenarios 3 and 4

We return to the numerical responses in section 4.2 below.

4 A dilemma?

4.1 Critical population size

The ethical principles underlying the scenarios are incompatible if the possible population is large enough. To see this consider the following argument in four steps.

1. Suppose there is a population of size $M+1$ containing 1 poor person (in the questionnaire this means with income below £10,000) and M rich people (with income above £50,000). Response A in Scenario 2 indicates that it would be acceptable to tax £1 from the poor person to give an amount Δ (where $\Delta = £100$) to each of the M rich people. So the reverse, where the rich lose £Δ and the poor person gains £1, would be unacceptable.

2. Now replicate $m-1$ times to give a population of size $n = m\,[M+1]$. Response A in Scenario 1 implies that it is acceptable to give G to one clone of the poor person and tax £1 from each of the rich people.

3. Equalize among all clones of the poor so that each of them gains G/m. This would be considered acceptable by respect for Progressive Transfers.

[15] "This may result in more people becoming poorer..."

4. Now repeat this operation $\Delta - 1$ times so that overall the rich lose £Δ and the poor gain $\Delta G/m$. Steps 2 and 3 above suggest that this should be acceptable; but if

$$\Delta G/m \leq 1 \tag{15}$$

step 1 above suggests that it must be unacceptable!

Clearly, for the contradiction in step 4 to occur, the replication factor m must be large enough for given Δ, G for (15) to hold: specifically we need $m \geq \Delta G$; this requires that the population size must satisfy $n \geq n^*$ where

$$n^* := \Delta G \left[M + 1 \right]. \tag{16}$$

In our questionnaire study Δ is fixed (at £100) but G and M are reported by the respondents who select A in scenarios 1 and 2. So the respondents effectively announce the critical value of n^*. The question we are interested in is whether, according to the respondents' views, the clash is severe (a low n^*) or weak (incompatibility only for astronomical populations).

4.2 A problem in practice?

We know that a large proportion – about a third – of our respondents fall into the "Anti-Anti" category – see table 2. For some of these the dilemma may prove to be a real practical problem[16] Rigorously speaking, the dilemma concerns only the respondents who endorse all four principles by answering A in all four scenarios: at NHH, there are 33 such students (7% of a total of 467); at LSE, there are 10 such students (8.5% of a total of 118). As we discussed in section 2 this implies a logical contradiction for very large populations. But we decided to focus on the larger subsample of the "Anti-Anti" category, because those who reject either progressive transfers or the irrelevance of replication do not necessarily have consistent views. Indeed, it would be possible to accommodate some of their concerns in our scenarios (such as respecting individual rights) and obtain a dilemma again. Moreover, there are versions of the dilemma that do not involve progressive transfers or replication invariance.

[16] There is a subcategory of the "Anti-Anti" group who, in the light of the argument of Sections 2 and 4.1, can be characterised as having incoherent preferences. These are the respondents who endorse all four principles by answering A in all four scenarios: at NHH, there are 33 such students (7% of a total of 467); at LSE, there are 10 such students (8.5% of a total of 118). As we discussed in section 2 this involves a logical contradiction for very large populations.

In order to investigate whether the dilemma is a practical problem, we need to look at how the AA types responded in the follow-up numerical questions on scenarios 1 and 2. Recall that question 2 on scenario 1 asked the respondent to report a value of G, given that answer A had already been selected on question 1; question 2 on scenario 2 asked for a value of M, given that answer A had already been selected on question 1. A lower value of G or a higher value of M are two different aspects of ethical values that give priority to the poor.

Table 4 presents a summary of the responses[17] and Figures 1 and 2 show the marginal distributions of the reported values of G and M. Table 4 reveals substantial heterogeneity of response across the subsamples. In particular, from the lower half of Table 4 we observe that the mean value of reported M for LSE is substantially greater than that for either of the NHH groups. We might expect G and M to be negatively correlated, so that both indicators of priority to the poor are in the same direction, so to speak; this is true for the NHH1 subsample, but not for LSE or NHH2.

Figure 1 shows that the distribution of the reported value of G is clearly bimodal; so too (from Figure 2) is the distribution of the reported value of M, where the mode at $M = 1$ is particularly pronounced. Two other things immediately stand out: this pattern is consistent across the three subsamples; in every case the median is much less than the mean (see also the first two parts of Table 4).[18]

The lower mode in Figures 1 and 2 is striking: in the case of scenario 2 almost a quarter of the respondents say that if just one rich person benefits from £100 this is worth cutting the poor person's income by £1. The presence of this mode might be interpreted in two ways: it could be taken as a left-censoring of the distribution of responses; or we can see a spike at the value 1 acting as a focal point for responses whose views are essentially "this is a good idea, whatever the numbers". The latter interpretation is clearly consistent with the comments of the AA-types who responded with the value £1 in scenario 1.[19] This interpretation is also consistent with each

[17] Invalid responses – such as specifiying a range of values rather than a single number – have been excluded. In each of Figures 1 to 3 the labelling of the horizontal axis gives the upper bound of each bin into which the observations have been sorted. So, for example, in Figure 1 the label £1,000 is for the bin containing all the observations from £101 to £1000.

[18] Figures 1 and 2 show the distribution just for AA types – those who responded "A" in *both* the first two scenarios. However if we plot the distributions of all responses to Scenario 1 question 2 and all responses to Scenario 2 question 2 we obtain the same shapes.

[19] "Any increase in income will be good for a person." "The amount is not relevant, seeing as those with high income lose little." "The ones who earn £50,000 have enough

	Median	Mean	Std. Dev.	Max	Obs	Corr (G, M)
			G			
LSE	1,000	6,533.73	12,420.93	50,000	30	0.1881
NHH1	1,000	2,705.90	5,408.53	40,000	69	-0.0729
NHH2	1,000	2,870.40	4,034.79	20,000	87	0.2376
All	1,000	3,400.24	6,663.96	50,000	186	0.1898
			M			
LSE	500	177,494.30	375,319.50	1,000,000	30	
NHH1	1,000	62,851.14	200,586.96	1,000,000	72	
NHH2	500	83,394.78	249,229.86	1,000,000	93	
All	1,000	90,286.29	258,297.03	1,000,000	195	
			n^* (millions)			
LSE	37.58	207,200.45	914,013.89	5,000,005	30	
NHH1	10.01	9,790.14	25,420.50	100,001	69	
NHH2	10.00	38,308.57	161,763.92	1,000,001	87	
All	10.01	54,969.78	384,720.27	5,000,005	186	

Notes: N(LSE)=39, N(NHH1)=75, N(NHH2)=98, N(ALL)=212
"Obs" is the number of valid numerical responses of G and of M
Minimum reported value of G and of M was 1

Table 4: AA types. Numerical responses in scenarios 1 and 2

of two threads of comment on scenario 2: that there is a clear overall income gain which must be desirable, whatever the value of M[20] or that the loss to the poor is vanishingly small.[21] The spike would probably have been lower if the rich person's gain in scenario 2 had been lower than £100.

Recall that the reported values of G and M can be used to derive the critical population size n^* above which the AA-position proves problematic in practice; for each individual respondent one simply applies the formula (16). Figure 3 shows the distribution of the resulting n^* for each subsample

money, and even the slightest increase of the ones who earn £10,000 is for the good." "£1 is better than nothing."

[20] There were many comments along the lines of "Here, the social surplus larger...," "this increases the total income in the economy, which is good," or "society earns £99."

[21] "£1 in a yearly income is barely noticeable."

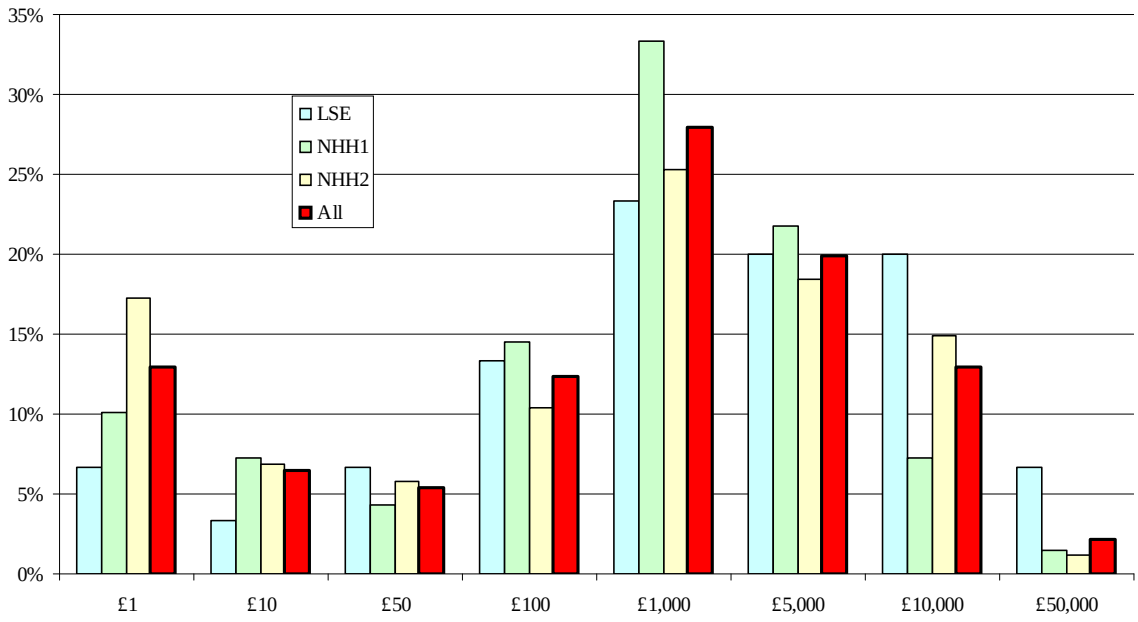

Figure 1: AA types. Distribution of G (Scenario 1 Question 2)

of respondents and overall; the bottom part of Table 4 gives the summary statistics for these distributions.

How large would n^* need to be to be effectively infinite, so that the puzzle becomes a practical problem? In Figure 3 the grey vertical line marks the position on the horizontal scale of the total population of the world and it is clear that a substantial proportion of each subsample of AA types lies to the right of this line and that some of those observations produce values that are hundreds of times the world population. It is also clear, from Table 4, that the mean value of n^* exceeds the present world population, but that the median is a much more modest number, about $37\frac{1}{2}$ million for the UK subsample, about 10 million for the NHH subsamples and overall. However, we might seek other reference groups to determine how large is "large." Table 5 gives the size n of a number of possible reference groups and the value of $F(n)$ where F is the empirical distribution function of the computed n^*.[22] If we compare the median value of n^* with any of these

[22] However, if we were to consider an application of our analysis to questions of intergen-

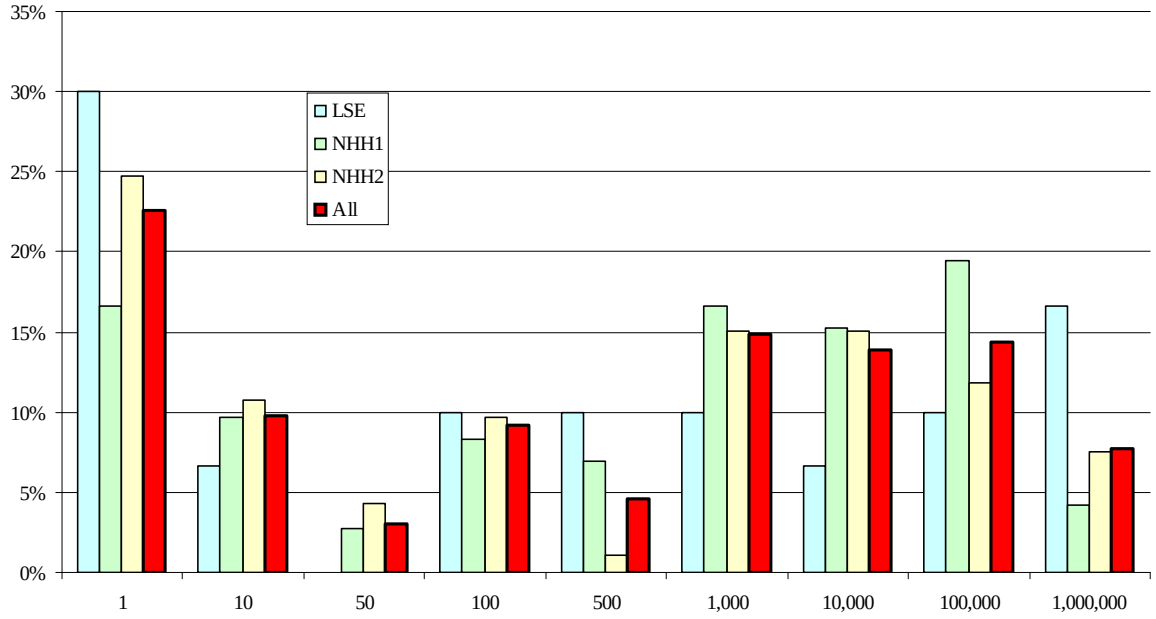

Figure 2: AA types. Distribution of M (Scenario 2 Question 2)

reference groups we can see that for Norway (and smaller countries) there is no problem of the two-tyrannies dilemma; for the UK and larger there is indeed a potential problem; Belgium is, perhaps, borderline. In summary, our analysis indicates that, for most individuals, this dilemma does not seem to be of practical importance for local moral questions only involving a small number of individuals. But it may be of importance for national considerations, and most likely is relevant for moral questions related to global and intergenerational injustice.

erational justice then a much larger reference group would be relevant. Asheim (2010) suggests that the number of people who will potentially live in the future is 10 million times the current world population; if this were added to Table 5 then clearly we would have $F(n) = 100\%$.

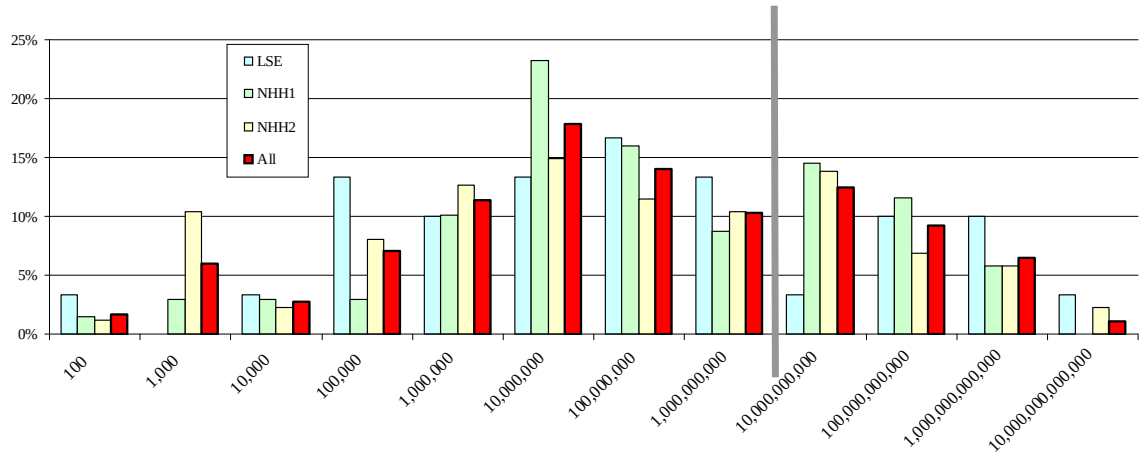

Figure 3: AA types. Distribution of Critical Population Size $n^* = 100G\,[M+1]$

5 Responses to the questionnaire – the effects of background

It is clear from the above discussion that there is considerable variability within the combined sample in the social values implied by the questionnaire responses. In order to understand what may drive the different responses we carry out some standard statistical analysis. First, in section 5.1, we look at the factors influencing the response patterns that were described in Section 3.3; then, in section 5.2, we look at the influences on the numerical values that determine the critical population size. Both parts of the analysis use the following background variables:

- **sex**: equals 1 if reported male, 0 otherwise
- **age**: in years
- **pol**: self-rated political views on a seven-point scale from left (1) to right (7)
- **familyincome**: self-rated income position of family looking back 10 years, on a seven-point scale from poor (1) to rich (7).

	n	$F(n)$
Vatican City	800	7.0%
Liechtenstein	35,789	14.0%
Luxembourg	502,207	23.1%
Norway	4,874,400	40.9%
Belgium	10,827,519	53.2%
UK	62,041,708	59.7%
Nigeria	154,729,000	65.6%
USA	309,003,000	66.7%
China	1,336,760,000	74.7%
World	*6,792,414,000*	*82.3%*

Source: United Nations Department of Economic and Social Affairs.2009

Table 5: AA types. Position of various reference groups in the n^* distribution

- **prospects**: self-rated prospective income position of self looking forward 10 years, coded as above.
- **nhh1**, **nhh2**: dummies for respondents from, respectively, the NHH1 and NHH2 subsamples.

In addition we had available two more variables related to the way in which the questionnaire session was run. To control for the possibility that the ordering of the first two scenarios might affect how people respond on the tyranny questions, half of the questionnaires presented scenarios 1 and 2 in reverse order. Also the order of finishing the questionnaires was preserved so that we have an ordinal indicator of the time that the respondents spent in completing the questionnaire.

- **version**: equals 1 if scenarios 1 and 2 were in the reverse order, 0 otherwise.
- **pos**: position of the observation in the sample; the smaller the number the longer the respondent had taken to complete the questionnaire.

5.1 Patterns of response

To investigate the determinants of particular patterns of response we estimate a standard probit model

$$\pi = \Phi(b_1 x_1 + b_2 x_2 + ... + b_n x_n) \tag{17}$$

where π is the probability of a particular response pattern, Φ is the normal distribution function, $(b_1, ..., b_n)$ is a vector of coefficients and $(x_1, ..., x_n)$ is a vector of characteristics. As a robustness check we applied this model both in an untransformed version – where the xs are simply the raw values of the variables described above – and a transformed version – where the explanatory variables familyincome and prospects are replaced by exp(familyincome) and exp(prospects).[23]

From the probit regression model some clear conclusions can be drawn about the characteristics that seem to predispose people to a particular response patterns. First consider the "basic" distributional principles, respect for Progressive Transfers and for Replication, where π in (17) means "probability that response conforms to the principle." Table 6 shows that being female or being more right wing means that you are more likely to respond in a manner contrary to the principle of progressive transfers (see the results from scenario 3): the female effect is in line with findings in other contexts (Amiel and Cowell 2002, 2007). Being female means that you are also more likely to reject Replication (see the results from scenario 4). The conclusions remain unchanged if we use the transformed version of the model; it is also clear that the other personal characteristics, version of the questionnaire, the length of time the person took over the responses and the subsample dummies play no role.

Now let us examine the responses to the "tyranny" questions – scenarios 1 and 2. Table 7 presents the outcome of applying the model (17) to the cases where $\pi = \Pr(\text{pattern } k)$ where k = AA, AB or BA; in each case we present the results for the standard list of explanatory variables and for an augmented model which incorporates the role of "Progressive Transfers" and "Replication attitudes" as possible determinants of responses to the first two scenarios. If the subject respects Progressive Transfers or Replication then he is more likely to respond A in scenario 1 (in the case of Progressive Transfers this is to be expected). As far as the four types in Table 1 are concerned, respecting Progressive Transfers increases the probability of being of type AB; violation of Replication reduces the probability that the person responds AA.[24] Once again political views and sex of the respondent are important: more right-wing political views increase the probability of a type BA response (not concerned about mob tyranny, concerned about individual tyranny) and decrease the probability of a type AB response; males

[23] We used this transformation because, instead of data recorded in monetary units (where it is common to take a log transformation), our data are on a scale of 1 to 7.

[24] It also increases the probability that the person responds BB.

	Progressive Transfers		Replication	
	untransformed	transformed	untransformed	transformed
version	-0.0202	-0.0092	-0.0100	-0.0009
	(-0.20)	(-0.09)	(-0.09)	(-0.01)
pos	0.0412	0.0498	-0.0408	-0.0199
	(0.23)	(0.28)	(-0.21)	(-0.10)
nhh1	0.0719	0.0457	0.0433	0.0310
	(0.46)	(0.30)	(0.27)	(0.19)
nhh2	0.1502	0.1306	-0.2211	-0.2328
	(0.98)	(0.86)	(-1.35)	(-1.43)
sex	0.1894*	0.2028*	0.1907	0.2163*
	(1.77)	(1.90)	(1.64)	(1.87)
age	-0.0027	-0.0013	-0.0115	-0.0071
	(-0.11)	(-0.06)	(-0.43)	(-0.27)
politicalviews	-0.2156***	-0.2158***	-0.0743	-0.0689
	(-4.55)	(-4.54)	(-1.48)	(-1.37)
familyincome	-0.0411	0.0000	-0.0273	-0.0001
	(-0.77)	(0.00)	(-0.48)	(-0.34)
prospects	-0.0043	-0.0002	0.1154	0.0002
	(-0.06)	(-0.68)	(1.51)	(0.92)
_cons	1.0210	0.8231	-0.5064	-0.2053
	(1.52)	(1.48)	(-0.69)	(-0.34)

Table 6: Probit Results for Scenario 3 (Progressive Transfers) and Scenario 4 (Replication)

are more likely to have a BA type of response pattern and less likely to be of AB type. Finally note that there is an ordering effect – putting scenario 2 first reduces the probability of an AB response and increases the probability of a BA response.

5.2 Reported thresholds – effects of background

We may also investigate the effect of background variables on the threshold income G (scenario 1, question 2) and the threshold number M (scenario 2, question 2). The principal results are summarised in Table 8. This reports the results of a simple log-linear regression of the log of the value reported – log(s1q2) and log(s2q2) – against the personal characteristics for

	Type AA		Type AB		Type BA	
version	0.0689	0.0672	-0.2326**	-0.2457**	0.2026*	0.2287*
	(-1.01)	(0.62)	(-2.14)	(-2.19)	(1.70)	(1.87)
pos	0.2244	0.2405	-0.0112	-0.0497	-0.0508	-0.0490
	(1.23)	(1.29)	(-0.06)	(-0.26)	(-0.24)	(-0.23)
nhh1	-0.0174	-0.0405	0.2463	0.1957	-0.0159	0.0673
	(-0.11)	(-0.26)	(1.50)	(1.17)	(-0.09)	(0.37)
nhh2	-0.0165	-0.0089	0.2571	0.1645	-0.0044	0.0778
	(-0.11)	(-0.06)	(1.58)	(0.98)	(-0.02)	(0.42)
sex	0.1319	0.0935	-0.1849*	-0.2124*	0.1694	0.1993
	(1.21)	(0.83)	(-1.66)	(-1.84)	(1.36)	(1.55)
age	-0.0030	-0.0028	0.0147	0.0174	-0.0354	-0.0437
	(-0.12)	(-0.11)	(0.59)	(0.70)	(-1.05)	(-1.26)
politicalviews	0.0434	0.0594	-0.1428***	-0.1283**	0.1070*	0.1126*
	(0.91)	(1.19)	(-2.92)	(-2.50)	(1.94)	(1.94)
familyincome	-0.0535	-0.0586	-0.0258	-0.0021	0.0360	0.0026
	(-0.98)	(-1.06)	(-0.45)	(-0.04)	(0.59)	(0.04)
prospects	0.0346	0.0085	-0.0875	-0.0905	0.0413	0.0341
	(0.49)	(0.12)	(-1.17)	(-1.18)	(0.52)	(0.42)
progressivetransfers		0.0039		0.2504**		-0.1160
		(0.04)		(2.19)		(-0.94)
replication		0.3279***		0.0740		-0.2176
		(2.74)		(0.59)		(-1.52)
_cons	-0.6972	-0.6709	0.3845	0.1055	-1.1975	-0.8335
	(-1.01)	(-0.95)	(0.55)	(0.15)	(-1.40)	(-0.94)

Table 7: Probit Results for Question 1 by types

the subsample of respondents who provided a non-null response to question 2 in each scenario. Once again we do this for the basic set of explanatory variables and for the augmented model where we also use the responses to scenarios 3 and 4 as explanatory variables.[25]

[25] As robustness checks we also did the following. (a) We tried using exp(familyincome) and exp(prospects) as explanatory variables rather than their untransformed counterparts – again this change in specification had no effect. (b) Using the same subsample of respondents we tried a simple linear regression of s1q2 and s2q2: in this case only nhh1 was significant (in the s1q2 equation). (c) We also ran the equations on the full sample applying a Heckman regression to allow for non-response on question 2 where the person gave response B rather than A in question 1. This led to a set of coefficient estimates and P-values that were very similar to those reported in the simple regression of Table 8.

	log(s1q2)		log(s2q2)	
version	-0.6750**	-0.6166*	1.9204***	2.1633***
	(-2.04)	(-1.81)	(3.74)	(4.17)
pos	-0.0461	0.1041	-0.1204	0.0339
	(-0.08)	(0.18)	(-0.13)	(0.04)
nhh1	-1.0029*	-0.9830*	0.7365	0.8753
	(-1.93)	(-1.88)	(0.90)	(1.07)
nhh2	-1.2340**	-1.2929**	-0.1073	-0.0535
	(-2.40)	(-2.46)	(-0.13)	(-0.07)
sex	-0.6091*	-0.5889*	-2.2660***	-2.3302***
	(-1.79)	(-1.67)	(-4.18)	(-4.18)
age	0.0769	0.0829	0.0606	0.0758
	(0.94)	(1.00)	(0.40)	(0.50)
politicalviews	0.4323***	0.4162***	-0.0443	-0.0591
	(2.88)	(2.66)	(-0.19)	(-0.24)
familyincome	-0.4008**	-0.4117**	0.1919	0.1847
	(-2.15)	(-2.17)	(0.72)	(0.69)
prospects	0.2398	0.1347	-0.6647**	-0.7872**
	(0.93)	(0.51)	(-1.98)	(-2.34)
progressivetransfers		-0.0467		0.7766
		(-0.13)		(1.44)
replication		0.0762		0.7961
		(0.21)		(1.41)
_cons	4.5041*	4.9465**	7.6591**	7.1676*
	(1.90)	(2.00)	(2.00)	(1.86)

Table 8: Regression Results for Question 2

For these numerical values income now plays a role, along with sex and political views; but the views on scenarios 3 and 4 play no role. Higher family income appears to make people "more generous" in that it is associated with a lower value of G, although it has no significant effect on M. By contrast higher income *prospects* have no significant effect on G, but are associated with a lower value of M (it makes people "less generous"). If the respondent is male this is likely to lower the value of G and of M.[26] However, if we were to regress critical population (the value of n^* computed from G and M) against the same sets of explanatory variables then sex, then the background variables are not significant. In other words sex, political views and the income variables explain G and M separately, but they do not explain their product; this makes sense because G and M more or less vary inversely over the whole sample.

6 Conclusion

We might have guessed that students are against tyranny. However, it is interesting that for the student respondents in our questionnaire experiment there was both a majority against individual tyranny *and* a majority against mob tyranny Indeed, in the four categories of possible responses in our "tyranny" scenarios, the "Anti-Anti" case is a clear winner. This fact is in the context of mainly coherent views from our respondents on all four principles (the two tyrannies plus progressive transfers and replication), backed by a large number of comments explaining the reasoning.

Whether there is a dilemma facing Anti-Anti people in practice depends on the size of the population under consideration, as we explained in section 2: think of this as the potential size of a reference group. We can compute the required critical size from the questionnaire responses and it is not necessarily astronomical: the reference group does not need to be all that large to present a problem. To summarise roughly, three quarters of our respondents would face a dilemma if the reference group were as huge as China; but (more surprisingly perhaps) about a quarter of our respondents would still face a dilemma if the reference group were as tiny as Luxembourg.

It makes sense that the respondent's background family income and expected future income may play a role in determining the critical numbers

[26] Respondents in the NHH1 subsample are likely to report a lower value of G and those in NHH2 are likely to report a higher value of M; once again there is an ordering effect in that the scenario that is presented first elicits the higher numerical response.

that we ask our respondents to provide. Political views and the respondent's sex also play a role in influencing these numbers and they influence the response categories themselves. Right-wingers and men are more willing to tolerate mob tyranny and less willing to tolerate individual tyranny – should we be surprised?

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A Appendix

The following is the standard version of the questionnaire used in this study. About half of the respondents received an alternate version that presented the second scenario before the first.

Questionnaire

Ethical views on the distribution of income

Thank you for participating in this survey. We are interested in *your opinion* on ethical issues related to the distribution of income in society. Your response will be most important for our research project, so we ask you carefully to consider the questions that we pose below. We are not looking for the "right" answers to the questions, so please feel free to express *your views* on these issues. The questionnaire is anonymous, so we will not at any point ask you to reveal your identity.

The questions are stated with reference to a society where the average annual income of an individual is £20,000 and the lowest annual income is £10,000, and where all individuals work equally hard and have the same needs. In this society, an annual income of £10,000 ensures a living standard slightly above the subsistence level, whereas an annual income of £20,000 ensures a decent living standard. In each of the scenarios we ask you to consider, there is an unforeseen event which happens this year. Its effects on people's living standards are limited to this year *only* and differ across income groups. So this means that in all the following years everybody's living standard are unaffected by this event.

Please note that this is not a test of logic. Each of the questions is a "stand alone", so it can be answered independently of any of the other questions.

Scenario 1:

- everyone with income over £50,000 experiences a £1 reduction in income;
- one person with income of £10,000 experiences an increase in income;
- no-one else is affected.

▪ Which of the following views do you agree with?

A: "if the gain for the person with £10,000 is sufficiently large, this is a good thing no matter how many people have incomes over £50,000" □

B: "even if the person with £10,000 gains a huge amount, this is not a good thing if there are very many people with incomes over £50,000" □

▪ If you selected **A**, how large must the gain be for the person with £10,000 to ensure that this is a good thing?

£1 □ £10 □ £50 □ £100 □ £500 □ £1,000 □ £5,000 □ £10,000 □ other (£_____)

▪ Please feel free to explain your answer: ……
……
……

Scenario 2:

- one person with income of £10,000 experiences a £1 reduction in income;
- all persons with income over £50,000 experience a £100 increase in income;
- no-one else is affected.

▪ Which of the following views do you agree with?

A: "if the number of persons with income over £50,000 is sufficiently large, this is a good thing" □

B: "even if the number of persons with income over £50,000 is very large, this is not a good thing" □

▪ If you selected **A**, how many people must have an income over £50,000 to ensure that this is a good thing?

1 □ 10 □ 50 □ 100 □ 500 □ 1,000 □ 10,000 □ 100,000 □ 1,000,000 □ other (_____)

▪ Please feel free to explain your answer: ……
……

Scenario 3:

- one person with income of £10,000 experiences an increase in income;
- one person with income of £50,000 experiences a corresponding decrease of exactly the same amount;
- no-one else is affected.

▪ Which of the following views do you agree with?

A: "this is a good thing, as long as the person who starts out with £10,000 does not end up richer than the person who starts out with £50,000" □

B: "even if the person who starts out with £10,000 does not end up richer than the person who starts out with £50,000, this is not necessarily a good thing" □

▪ Please feel free to explain your answer:
……

Scenario 4:

- everyone with income of £10,000 experience an increase in income;
- everyone with income of £50,000 experience a decrease in income;
- no-one else is affected.

▪ Which of the following views do you agree with?

A: "if this were a good thing, then it would also be a good thing if the number of persons at all income levels in society were doubled (i.e., a doubling of the number of persons with £10,000, £50,000, and so on)" ☐

B: "even if this were a good thing, it would not necessarily be a good thing if the number of persons at all income levels in society were doubled (i.e., a doubling of the number of persons with £10,000, £50,000, and so on)" ☐

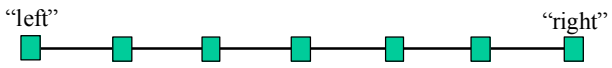
▪ Please feel free to explain your answer:

……

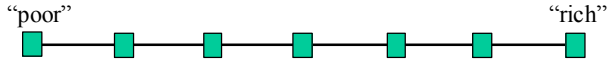
Background information

- What is your age? _____ years
- What is your gender? Male☐ Female☐
- Are you a student? Y☐ N☐
- (For students) What is your field? _____
- (For employed non-students) What is your profession? _____

- How would you rate your political views? Please put a √ on this scale.



- "How would you rate your family's income ten years ago (relative to average income in the country where you lived then)?"



- "How would you rate your own income prospects ten years from now (relative to average income in the country where you plan to live)?"