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Managing Social Risk: an impartial spectator's perspective on tradeoffs between inequality and risk

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Abstract

Public risks entail a distribution of risk in groups and members of the society. This paper collects and analyses experimental evidence of a between-subjects research design in which impartial spectators choose their most preferred risk allocation procedure in pairwise comparisons. Risk allocation procedures are conceptualised using two essential dimensions: the level of *inequality* concerning the distribution of risks and outcomes over various groups and members of the society and the level of *risk* faced by individuals and society as a whole. In the presence of uncertainty, attitudes towards inequality and risk interact with each other, yet the binary choices of impartial spectators in the experiment allow us to disentangle these motives. Results obtained through a logit model, used to estimate the relative importance of inequality and risk motives, reject the hypothesis that social planners maximize a utilitarian social welfare function with self-regarding preferences as inputs. Instead, they seem to care about *ex-ante inequality*, *ex-post inequality*, *individual risk* and *collective risk*. Furthermore, the amount of resources available for redistribution and the presence of ex-ante inequality, as well as political orientation and shared experiences with the beneficiaries all moderate attitudes towards inequality and risk. A double clustering estimation procedure also reveals the possibility that social planners are influenced by allocation specific characteristics other than inequality and risk.

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1 Introduction

The perceived fairness of policy decisions can either enhance their political acceptability (Gaertner and Schokkaert, 2011) or deteriorate their implementation (Krugman, 2009), especially in political democracy, where such decisions cannot but receive the general support from the public[1]. In the health care sector, constrained financial resources, even in the richest of countries, require policy makers who are faced with competing demands to set priorities in the distribution of health treatments (Newdick, 2005). In the UK, for instance, decision makers at regional and national levels are responsible for making difficult resource allocation decisions, on the basis of sometimes unclear criteria (Newdick, 2005) which the UK National Health Service aims to make more explicit by moving its new policy objectives closer to the views of the general public (Department of Health, 2001). These priorities concern situations where judgment about the distribution of different treatments to different patients needs to be made.

The first empirical evidence on people's perception of fair allocation rules came from the seminal works of Yaari and Bar-Hillel (1984) and Kahneman, Knetsch, and Thaler (1986) who studied distribution preferences of involved stakeholders in a risk-free setting and showed that these are highly context dependent and that individuals are willing to enforce economic fairness at some cost to themselves. The samples of students who participated in these studies decisively rejected a distribution-neutral utilitarian social welfare function of self-regarding individual expected utilities. Since then, many studies have explored distributive sensitive preferences, while several theoretical contributions (Rabin, 1993; Schmidt and Fehr, 1999; Bolton and Ockenfels, 2000; Charness and Rabin, 2002; Cox, Sadiraj, and Sadiraj, 2008; Andreoni and Miller, 2002) have explained in a rigorous and tractable manner observed phenomena of altruistic, fairness, and reciprocity concerns in the distribution of resources (Fehr and Schmidt, 2006).

The above studies have explored so called 'other regarding preferences' in a deterministic environment where final outcomes are known ex-ante. However, concerns about the distribution of outcomes cannot be extrapolated to concerns about the distribution of risk using expected utility theory as is implicit in some of this work (Fudenberg and Levine, 2012), hence it is not obvious how to translate these findings in risky environments where final outcomes are uncertain[2]. This paper extends these studies in a risky setting and investigates impartial preferences of risk allocation procedures in the domain of health when outcomes are uncertain. By holding the object of distribution constant, we are able to investigate preferences of a different type of priority setting, one that inevitably emerges when resource allocation decisions are made in the presence of uncertainty. This priority

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[1]Sen (2009) has developed this argument further, suggesting that ethically attractive solutions to distributional conflicts should not only be logically consistent with the set of axioms that they consists in, but they should also be endorsed by the concerned ones.

[2]See Fleurbaey (2011), Mongin and Pivato (2016), Fleurbaey (2018), and Miyagishima (2019) for the tensions between equity, efficiency and social rationality in the evaluation of social situations under risk and uncertainty.

setting refers to how social planners order the relative importance of inequality and risk in the distribution of a hypothetical treatment of nerve block therapies to patients suffering from chronic low back pain.

Impartiality requires choices to be independent of selfish and strategic concerns. In order to rule out these motives we consider the preferences of a (hypothetical) policy maker whose decisions do not affect by any means her own (hypothetical monetary) wealth[3]. These decisions are less likely to be biased and more likely to be impartial, since they reflect those of a social planner (Smith, 1759)[4]. Examples of such situations would include: government officials and policy makers deciding for their citizens, sports team coaches deciding for their athletes, community leaders deciding for other residents or doctors deciding for their patients (Rohde and Rohde, 2015). The unbiasedness and robustness[5] of such preferences makes them highly relevant for social choice theory and public policy (Konow, 2009), especially in the presence of uncertainty[6].

Conventional health economics is concerned with efficiency in the distribution of health treatments. The quantification of health gains is thus necessary in this maximization problem and is usually operationalized with the use of Quality Adjusted Life Years (QALY)

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[3]To illustrate the effect of selfishness in just allocation decisions, consider a typical setting of a Dictator game. If purely selfish motives drive proposer's decision, one would expect that nothing is given to the recipient, while a fifty-fifty allocation would be chosen if purely social motives underlie his preferences. Any value in between these two extremes (zero and fifty percent) is the combined outcome of selfish and social motives, hence it represents a distorted view of social preferences due to self-serving and moral biases (Babcock and Loewenstein, 1997).

[4]Two notions of impartiality coexist in the literature of distributive justice. One is advocated by Rawls (1971), who claims that perceptions of fairness should be elicited by placing involved stakeholders in the so called 'original position' which is a hypothetical situation where a 'veil of ignorance' restricts any relevant information to decision makers regarding their relative place in society. Assuming infinite risk averse decision makers, he then proposes a maximin principle of justice based on which allocation procedures should favor the least well-off (with respect to the outcome variable that is distributed in the given allocation problem) individual in society. Adam Smith conceptualises impartiality in a different way, attributing three main characteristics to his impartial spectator: impartiality (disinterested social planner not guided by traces of self interest), information (social planner has all relevant information) and sympathy (social planner is sympathetic to the concerned ones by understanding their experiences and sharing their feelings). Amiel, Cowell, and Gaertner (2012) and Amiel, Cowell, and Gaertner (2009) tested the two notions of impartiality next to each other and found that there is a significant interaction between those and attitudes towards redistribution. The Smithian conception of impartiality has been chosen here on the grounds of experimental evidence showing strategic considerations (Gerber, Nicklisch, and Voigt, 2014) in the redistributive choices of decision makers when they are placed behind the 'veil of ignorance'. Furthermore, Konow (2009) showed that by manipulating the amount of information available to decision makers, higher levels of convergence of moral views can be reached as information increases. This goes against Rawls' argument that a unanimous agreement regarding a just distribution of resources requires impartial spectators to be deprived of any relevant information.

[5]The possibility that the lack of monetary (or other) incentives makes impartial spectators in a hypothetical scenario choose randomly, is eliminated on the grounds of the disutility individuals experience when actual allocations deviate from what they deem as just (Karni and Safra, 2002; Konow, 2009; Birkeland and Tungodden, 2014). Empirical evidence showing that uninvolved spectators indeed implement just choices are presented in Konow (2000) and Cappelen et al. (2013).

[6]A subjective and self-oriented interpretation of fairness is more likely to occur by involved stakeholders than by uninvolved social planners (Babcock et al., 1995; Babcock and Loewenstein, 1997; Rodriguez-Lara and Moreno-Garrido, 2012), a pattern that is amplified in the presence of uncertainty, when information about the relation between actions and outcomes can be chosen selectively (Dana, Cain, and Dawes, 2006; Dana, Weber, and Kuang, 2007), leading decision makers to allocate more to themselves in the presence of risk (Klempt and Pull, 2010), thus being more prone to self-serving biases (Cettolin and Riedl, 2016).

(Sassi, 2006) which is a measurement that combines quality and duration of life. Increases in duration and quality of life, as well as in the number of patients who receive a treatment, are all assumed to increase societal well being (Dolan et al., 2005). Thus, in the distribution of health treatments, efficiency concerns are expressed with the maximization of QALYs and indifference towards the distribution of QALYs (Nord et al., 1995; Dolan et al., 2005) is justified on the grounds of Pareto efficiency (Kaldor, 1939). However, in addition to health gains, empirical evidence suggest that reductions in efficiency in order to promote equity may also increase social welfare (Schwappach, 2002; Dolan et al., 2005; Stafinski et al., 2011). The well known equity-efficiency tradeoff, has been evaluated in a number of studies and the results remain inconclusive as to what extent preferences are consistent with the distribution-neutral QALY maximization rule (Schwappach, 2003; Dolan, Edlin, and Tsuchiya, 2008; Green and Gerard, 2009; Lancsar et al., 2011; Norman et al., 2013). This study contributes to the literature of health economics with a test against the hypothesis that impartial spectators exhibit distribution-neutral preferences over risk allocation procedures.

Risk allocation procedures can be thought of as the outcome of public risks. Public risks, such as climate change (Rheinberger and Treich, 2017; Schofield, 2015), terrorist attacks (Fischbacher-Smith and Fischbacher-Smith, 2013) and financial crises, receive increased attention (Quiggin, 2007) as they consist of harmful events that can affect the lives of many citizens simultaneously, but not (necessarily) equally. When no evidence about the likelihood of a particular kind of harmful event is available, organizations and policy makers have no clear guidelines of how to deal with it, and yet to maintain normality while preparing for the worst (Moynihan, 2012). I argue that the way impartial spectators evaluate such tradeoffs in the presence of social risks can be insightful.

The following questions resemble those asked in the online experiment and help to illustrate situations where impartial preferences over risk allocation procedures can be informative: *should one deliver a vaccine that works moderately well for everybody or one that fully eliminates the risks of the disease for some but not all patients?* Similarly, *should one prefer a moderate but risk-less solution over a new risky vaccine that may save more lives with some probability but may also induce strong adverse reactions for everyone* (Adler and Sanchirico, 2006)? The underlying uncertainty of the options available to the decision maker, in both questions, is present in many real life situations and adds an extra layer of risk in their analysis, as it is not only the individuals (in this case patients) who face a risk, but society as a whole. The collective dimension of those risks requires policy makers to evaluate them not only from an individual, but also from a broader societal perspective. The experimental design of this paper allows us to disentangle the two essential dimensions of those risks: the degree of *inequality* concerning the distribution of risks over various groups and individuals and the degree of *risk* faced by individuals and society as a whole (Rohde and Rohde, 2015). Understanding how these two dimensions influence people's preferences of risk allocation procedures can improve theories of public

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risk and help policy makers design welfare increasing policies by setting priorities in the distribution of health gains that satisfy societal preferences (Mooney, 1998).

The notion of public risk was first introduced by Keeney (1980a,b) in the context of binary, life and death, outcomes. He showed that in addition to the risk faced by individuals, in a risky setting where final outcomes are uncertain, the distribution of the number of fatalities over different states of the world matters as well. The dispersion of these collective outcomes (which in the framework of Keeney are number of fatalities, but they may as well be any aggregate social outcome) is how one can quantify collective risk which should be taken into consideration in the decisions to allocate risk over society (Fishburn and Sarin, 1991; Keeney and Winkler, 1985; Sarin, 1985; Gajdos, Weymark, and Zoli, 2010). The online experiment of this study considers risk allocation procedures over patients suffering from chronic low back pain that differ in terms of individual and collective risk.

Nevertheless, the conceptualization of public risks should move beyond the individual and collective outcomes of risk allocation procedures. Keller and Sarin (1988) showed that next to the aggregate upshots to various members of the society, the perceived fairness of the distribution of risks influence preferences for one policy alternative over the other. Experimental evidence from (extensions to) probabilistic dictator and ultimatum games (Bolton, Brandts, and Ockenfels, 2005; Karni, Salmon, and Sopher, 2008; Lelec and Krawczyk, 2010; Brock, Lange, and Ozbay, 2013; Van Koten, Ortmann, and Babicky, 2013; Owens, 2016; Cettolin and Riedl, 2016; Miao and Zhong, 2018) show that subjects are willing to assign a non-zero probability of receiving the unfavourable outcome to themselves in order to share the opportunity to receive the full amount of money with the recipient, hence exhibiting aversion to unequal opportunities. In addition, many of these (and other) studies (Keller and Sarin, 1988; Bolton, Brandts, and Ockenfels, 2005; Lelec and Krawczyk, 2010; Brock, Lange, and Ozbay, 2013; Cappelen et al., 2013) find that procedural fairness alone cannot explain behavior, suggesting that generalizing social concerns in risky environments needs to rely both on distributive and procedural motives, as theory suggests (Harsanyi, 1955; Diamond, 1967; Sarin, 1985; Trautmann, 2009; Fleurbaey, 2010; Saito, 2013). In line with this literature, we consider risk allocation procedures that generate different levels of inequality before and after the resolution of uncertainty, thus being different in terms of the procedures that generate the outcome and in terms of the eventual allocation of outcomes.

In addition to the explanatory power inequality and risk attitudes have in preferences over risk allocation procedures, further experimental evidence suggests that they should not be considered in isolation (Lopez-Vargas, 2014; Freundt and Lange, 2017). In particular, subjects in Lopez-Vargas (2014) were willing to take substantially more risks when outcomes were ex-post unfair compared to when they were ex-post fair, showing a clear link between social considerations and risk preferences. In light of these observations, our methodology is based on a unified framework which integrates concerns for both inequality

and risk and allows us to elicit the relative weights of these motives. The risk allocation procedures we consider are different only in terms of ex-ante inequality, ex-post inequality, individual risk and collective risk.

In order to illustrate the implications of the four inequality and risk concepts let us go back to the questions regarding the distribution of vaccines that we posed before. In the first question, a social planner needs to decide between delivering a vaccine that works moderately well for everybody and one that can fully alleviate the symptoms of the disease for some, but not all patients. If the social planner favours the second option, or in cases when a risk-less and ex-post equal solution is not available, should she give everyone the same opportunity to receive the vaccine or should she give priority to particular patients who might be more in need of it? Is equality of opportunity socially superior to solidarity[7]? This question is very relevant in many other real life situations, such as admission procedures in higher education, design of rescue plans in case of calamities and allocation of organ donors (Childress, 2001). Health economics literature on distributional weights suggests that, even though there is heterogeneity, people with high socioeconomic status tend to receive lower priority (Gu et al., 2015). We test the replicability of this finding in a risky context by introducing three different deterministic allocations that each favours a group of patients with higher education, lower income and Dutch nationality in an attempt to represent, respectively, a high, low and a rather neutral socioeconomic status group of patients.

Next, consider the second question where a decision maker decides between a moderate risk-less option and a risky one where either all patients receive a highly effective treatment or they all receive nothing. Notice, that the risky option here entails dependent risks for the patients. If the social planner deems the moderate treatment as insufficient, or if the risk-less option is not available at all to her, would she prefer an allocation rule based on dependent or independent risks? An allocation rule based on independent risks, in this context, is one that offers to each patient an independent lottery to receive, or not, the treatment in such a way that the outcome of one patient's lottery does not affect the outcome of other patients' lotteries. Accordingly, an allocation rule based on dependent risks consist of a lottery that is resolved only once and the outcome is applied to everyone. Whether or not a person finds the two risky allocation rules different from each other depends partly on the relative weights she attaches to inequality and risk. If she cares only about risk, the social planner would be indifferent between allocation rules of independent and dependent risks, as in both allocation procedures all patients get the same lottery, thereby having the same opportunity to receive the treatment, so that there is no inequality in terms of the risk each patient faces. By contrast, if the decision maker

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[7]We aim to shed light on these questions not by discussing the normative implications of various points of views, but by obtaining a descriptively accurate image of how social planners evaluate these situations. The argument that justifies such an approach to rather ethical in nature questions was presented in the beginning of the introduction.

cares only about inequality, she would argue that the two procedures are not equivalent because, in the case of dependent risks, there will always be no inequality after resolution of uncertainty, whereas in the case of independent risks it is very likely that there will be inequality after resolution of uncertainty[8]. This example shows that the order in which inequality and risk are processed can affect impartial spectators' concerns for procedural fairness (Rohde and Rohde, 2015).

These tradeoffs are evaluated in two hypothetical scenarios where social planners decide between risk allocations procedures that differ only in terms of inequalities and risks. In these scenarios, we manipulate the amount of resources social planners have available for redistribution in order to explore their attitudes against varying degrees of health gains.

The results suggest a preference for a risk allocation rule that assigns the same probability to each patient to receive the treatment, though this attitude varies with the nature of the deterministic allocation: social planners are indifferent between equality of opportunity and solidarity when lower income patients are favoured by the deterministic allocation, while they are averse towards ex-ante inequalities when patients with higher education and Dutch nationality are given priority. Furthermore, I find that attitudes towards collective risk are vulnerable to allocation specific criteria other than inequalities and risks. Also, attitudes towards ex-post inequality change significantly across the two experimental conditions, a shift that is associated with levels of ex-ante inequality. Moreover, I replicate in the domain of health the findings of Rohde and Rohde (2015) who observed significant ex-post inequality seeking and collective risk seeking showing why, even though surprising at first sight, they do not contradict existing literature. Finally, heterogeneity analysis on a set of individual specific characteristics, reveals that social planners' attitudes towards inequality and risk are moderated by political orientation and past experiences with the disease.

The rest of the paper is structured as follows. In Section 2 I outline a theoretical framework of public risk and explain how inequalities and risks are operationalized. In Section 3 and 4 the experimental design and analysis are described in detail, while in Section 5 I present the results. In Section 6 I discuss interesting avenues of future research before concluding in Section 7.

2 Public Risk: Inequality and Risk

The types of risk allocation presented in the questionnaire differ only in terms of ex-ante inequality, ex-post inequality, individual risk and collective risk. In this section, I demonstrate how choices over such allocation procedures allow us to disentangle attitudes towards these motives and formally operationalize them by providing exact definitions.

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[8]Note that an allocation rule based on independent risk is similar to an allocation rule based on dependent risks in terms of ex-ante inequality, since in both everyone has the same opportunity to receive the benefits the lottery.

2.1 Conceptual distinctions

In a simplified framework with two persons, let us consider the comparison between two allocation procedures that distribute an arbitrary selected, but equally valuable to both persons, resource material. The first example is from Diamond (1967). A fair coin is flipped once to determine the utility level of the two persons in our example, Ann and Bob. In Procedure I (PI) Ann ends up with two utils in the case of heads and zero in the case of tails, while the reversed outcome applies to Bob. In Procedure II (PII) Ann ends up with two utils and Bob with zero, irrespective of the outcome of the coin flip. Table 1 summarizes the utility levels of Ann and Bob.

Table 1: Example I

	Procedure I		Procedure II	
	Heads	Tails	Heads	Tails
Ann	2	0	2	2
Bob	0	2	0	0

In both procedures, the eventual allocation of utils is unequal, since it is always either Ann, or Bob, who derive two utils after the resolution of uncertainty. Therefore, there is ex-post inequality in both PI and PII. This implies that a social planner concerned only with ex-post inequality would be indifferent between the two allocation procedures. However, the dispersion of individual expected utilities is not the same in the two procedures, as Ann and Bob face different expected utilities only in PII, but not in PI. An ex-ante inequality averse social planner would prefer PI to PII. This illustrates the difference between ex-ante and ex-post inequality.

In both procedures, it is always two levels of utility that are being allocated, hence collective risk is zero in both. However, they do differ in terms of individual risk, with PI being riskier than PII, as it comes with a larger spread of possible outcomes from the perspective of the individual[9]. Considering that both procedures do not differ in terms of ex-post inequality and collective risk, the social planner who is individual risk seeking and ex-ante inequality averse would undoubtedly choose PI. However, if he were individual risk averse (seeking) and ex-ante inequality averse (seeking) we would not be able to predict his choice: individual risk aversion would favor PII, whereas ex-ante inequality aversion would favour PI. In this case, the relative weight he attaches to ex-ante inequality and individual risk would determine his preference.

The next example is from Rohde and Rohde (2015) and helps to illustrate the difference between the two risk concepts. Consider a third way to allocate the material resource between Ann and Bob, Procedure III (PIII), where the coin is flipped twice, each time

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[9]In this paper, the notion of individual risk refers to individuals who are affected by the allocation procedure, in these examples to Ann and Bob, not to the social planner who is deciding on their behalf.

for each individual separately so that utility levels are determined independently. Let us compare PIII to PI from the previous example. The utility levels are summarized in Table 2. If a social planner were merely concerned with ex-ante inequality and/or individual risk he would be indifferent between the two procedures, arguing that the distribution of individual expected utilities is the same in both procedures. However, PI and PIII are different in terms of ex-post inequality and collective risk: PIII yields lower level of ex-post inequality than PI, as it is more likely that there will be no inequality after the resolution of the uncertainty, and higher levels of collective risk, as it is riskier than PI in terms of total payoffs. The social planner would then prefer PIII if he were ex-post inequality averse and collective risk seeking, but PI if he were ex-post inequality seeking and collective risk averse. Accordingly, it would have been impossible to predict his preference if he were collective risk averse (seeking) and ex-post inequality averse (seeking). In this case, the relative weight he attaches to ex-post inequality and collective risk would determine his preference.

Table 2: Example II

	Procedure I		Procedure III			
	Heads	Tails	H-H	H-T	T-H	T-T
Ann	2	0	2	2	0	0
Bob	0	2	2	0	2	0

Let us now consider a third example where a social planner is asked to choose between PI and a fourth procedure, Procedure IV (PIV), which allocates to Ann and Bob the expected value, in terms of utils, of the lottery they face in PI, without any risk. The levels of utilities are summarized in Table 3. These two procedures are equivalent in terms of ex-ante inequality and collective risk because, in both procedures, there are no differences in individual expected values and total levels utility across the two states of the world. Hence, a social planner who was merely concerned with ex-ante inequality and/or collective risk would be indifferent between the two. Yet, PI and PIV do differ in terms of ex-post inequality and individual risk: PIV generates no ex-post inequality and no individual risk as both individuals receive the same outcome, with certainty. Therefore, ex-post inequality and individual risk aversion would make the social planner choose PIV, while ex-post inequality and individual risk seeking would make him choose PI. Accordingly, if he were ex-post inequality seeking (averse) and individual risk averse (seeking), it would have been impossible for us to predict his preference as this would depend on the relative weight he attaches to each motive.

The above examples show the distinction between the four inequality and risk concepts. Most importantly, they show that they are not completely independent from each other and that it is sometimes impossible to disentangle one from the other: example one shows that for ex-ante inequality and individual risk, example two for ex-post inequality and collective

Table 3: Example III

	Procedure I		Procedure IV	
	Tails	Heads	Tails	Heads
Ann	2	0	1	1
Bob	0	2	1	1

risk and example three for ex-post inequality and individual risk. In the online experiment of this study social planners are presented with a set of seven allocation procedures that are similar to the above examples and those considered in the experiment of Rohde and Rohde (2015) with real monetary incentives, while their analysis in pairwise comparisons will allows us to disentangle attitudes towards these motives and to circumvent their interdependencies. Next, I formally define the notions of inequalities and risks used in the above examples.

2.2   Definitions

Inequality and risk are dispersions of outcomes over individuals and states of the world (Rohde and Rohde, 2015). Depending on the time of measurement, I use the term ex-post when inequality and risk are measured after the distribution of the payoffs has been made, and ex-ante when the action of measurement takes place before. In other words, ex-ante allocation looks at the prospects being offered to the participants when payoffs are distributed in a particular way, whereas an ex-post allocation considers only the resulted payoffs. For the operationalization of inequality and risk I use the standard deviation of the corresponding dispersions of outcomes.

An *ex-post allocation* $\mathbf{X}=(x_1,...,x_n)$ yields outcome $x_i \in R$ to individual i, thus specifying the payoffs of each individual (except from the decision maker who acts as a social planner whose outcome is not determined by any Allocation Type). An *ex-ante allocation* $\mathbf{L}=(p_1:x_1,...,p_m;x_m)$ for any finite m yields ex-post allocation x_j with probability p_j for any $j=1,...,m$. An ex-post allocation results after risk is resolved, whereas ex-ante allocation is a lottery of ex-post allocations and thus describes the probability of a particular ex-post allocation to result. Note, that x_1 in ex-post allocation X is not the same as X_1 in ex-ante allocation $\mathbf{L}$. The outcome of individual i in ex-post allocation x_j is denoted by $x_{i,j}$.

We may define the four inequality and risk concepts as follows:

- *Ex-ante inequality* as the standard deviation of the distribution of individual expected values:

$$EAI(L) = \sqrt{\sum_{i=1}^{n} \frac{1}{n} \big(IEV_i(L) - \overline{IEV}(L)\big)^2}$$

where

$$IEV_i(L) = \sum_{j=1}^{m} p_j x_{i,j}$$

is the *individual expected value* of individual i in ex-ante allocation $\mathbf{L} = (p_1 : x_1, ..., p_m; x_m)$ and

$$\overline{IEV_i}(L) = \sum_{i=1}^{n} \frac{1}{n} IEV_i(L)$$

is the *average expected value* of ex-ante allocation $\mathbf{L}$.

- *Expected ex-post inequality* of ex-ante allocation $\mathbf{L} = (p_1 : x_1, ..., p_m; x_m)$ as:

$$EEPI(x) = \sum_{j=1}^{m} \big(p_j EPI(x_j)\big)$$

where

$$EPI(x) = \sqrt{\sum_{i=1}^{n} \frac{1}{n} \big(x_i - \overline{x}\big)^2}$$

is the *ex-post inequality* of ex-post allocation $\mathbf{X} = (x_1, ..., x_n)$ given by the standard deviation of the ex-post distribution and

$$\overline{x} = \sum_{i=1}^{n} \frac{1}{n} x_i$$

is the *ex-post average payoff* of ex post allocation $\mathbf{X} = (x_1, ..., x_n)$.

The order in which the decision maker processes the risk and interpersonal dimension of the *ex-ante allocation* L determines her priority between ex-ante inequality and ex-post inequality: if she cares only about ex-ante inequality she prioritizes the risk dimension, whereas if she cares only about ex-post inequality she prioritizes the interpersonal dimension Rohde and Rohde (2015).

- *Individual risk* of individual i in ex-ante allocation $\mathbf{L}=(p_1 : x_1, ..., p_m; x_m)$ is:

$$IR_i(L) = \sqrt{\sum_{j=1}^{m} p_j (x_{i,j} - IEV_i(L))^2}$$

- *Collective risk* of ex-ante allocation $\mathbf{L}=(p_1 : x_1, ..., p_m; x_m)$ as:

$$CR(L) = \sqrt{\sum_{j=1}^{m} p_j \left(\left(\sum_{i=1}^{n} x_{i,j} \right) - CEV(L) \right)^2}$$

where

$$CEV(L) = \sum_{j=1}^{m} p_j \left(\sum_{i=1}^{n} x_{i,j} \right)$$

is the *collective expected value* of ex ante allocation $\mathbf{L}=(p_1 : x_1, ..., p_m; x_m)$.

For each of the seven Allocation Types considered in the questionnaire, exact measures have been calculated[10] and presented in Table 4, for each inequality and risk concept. If the social planner strictly prefers ex-ante allocations with lower (higher) ex-ante inequality, I say that he is ex-ante inequality averse (seeking), assuming everything else remains constant. If ex-ante inequality does not play any role in his preferences, I say that he is ex-ante inequality neutral. Ex-post inequality, individual and collective risk are characterized by aversion, neutrality and seeking in a similar way.

3 Experimental Design

An online experiment was conducted by disseminating a questionnaire via the online platform Qualtrics. Subjects were presented with a hypothetical scenario in which they work for the Health Ministry of the Netherlands and they have to decide on how to allocate a limited amount of resources in the form of a health treatment among patients who suffer from severe chronic low back pain[11]. The design of this online experiment is similar in many, but not all, aspects to the one of Rohde and Rohde (2015). There are two main differences: first, I consider a wider range of risk allocation procedures which favour a predetermined group of individuals; second, I elicit attitudes towards inequality and risk in a hypothetical scenario instead of a real laboratory environment, where a health treatment, instead of real money are distributed by the social planner [12]. Two hypothetical scenarios

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[10]Exact calculations are provided in Appendix C.

[11]See Appendix A for experimental instructions.

[12]Monetary incentives are known to be very effective in eliciting individual preferences that might reflect real life situations more accurately. This implies that experiments using such incentives would score relatively high on external validity. Yet, certain decision making environments either do not involve monetary incentives or they involve much higher payoffs than the experimenter can afford to offer. Therefore,

constitute two experimental conditions of a between subjects research design. The two scenarios are exactly the same with respect to the task respondents in the questionnaire need to accomplish: they are asked to indicate their preferences over different (but the same across the two experimental conditions) risk allocation procedures. The risk refers to the probability that a patient receives the therapy, which is a set of nerve block therapies offered over a given period of time. The therapy remains the same and is offered for the same amount of time in all allocation procedures, thereby being equally beneficial to those patients receiving it. The difference between the two scenarios lies in the probability that a patient receives the treatment. In the *well-off* (*worst-off*) scenario the government possesses a larger (smaller) amount of resources available for redistribution, hence there is a larger (smaller) probability that a patient is treated in the lotteries and a larger (smaller) number of patients who are benefited by the distributions. Within each group, subjects are not affected by their choices hence preferences reveal those of a social planner.

3.1 Allocation Types

The seven Allocation Types that subjects were presented with allow us to disentangle attitudes towards inequality and risk. In a setting of n individuals, where $n = 1, ..., 10$ we are interested in the choices social planners make on how to distribute risk among n individuals. Note, that in total (including the social planner) there are $n + 1$ individuals, but since the social planner is not affected by his choices, he is not identified within n.

The distribution of risk is (hypothetically) materialized among patients who are all at the age of 42 with life expectancy (independent of receiving the treatment) of 82 years. Social planners in the *well-off* condition of the online experiment were presented with the following Allocation Types:

- **Independent Lottery** (70%: Treatment for 40 years, 30%: No treatment)

  All patients have the same probability of 70% to receive the treatment, independently. Hence, the lottery (70%: Treatment for 40 years, 30%: No treatment) is resolved 10 times.

- **Common Lottery** (70%: Treatment for 40 years, 30%: No treatment)

  The lottery (70%: Treatment for 40 years, 30%: No treatment) is resolved only once and the same outcome applies to all patients.

- **Random Distribution** (7: Treatment for 40 years, 3: No treatment)

  Seven out of the ten patients are randomly selected to receive the treatment and three not to receive the treatment. All ten have equal probability of being selected.

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following Kahneman and Tversky (1979) I argue that choices between large hypothetical payoffs, when these are large, would offer a different, still valuable perspective on individual preferences.

- **Education/Income/Nationality Based Distribution** (7: Treatment for 40 years, 3: No treatment)

  Seven out of the ten patients are randomly selected to receive the treatment and three not to receive the treatment. The selection is determined by the patients' level of income, education and nationality (see Subsection 3.2 for details)

- **Common Outcome** (10: Treatment for 28 years)

  All individuals receive the treatment for a shorter period of time (28 years instead of 40) compared to the previous Allocation Types.

In the *worst-off* scenario everything remains the same except for the probability of receiving the treatment in the Independent Lottery and Common Lottery, which is 20% instead of 70%, the number of patients who are about to receive the therapy in the Random and Education/Income/Nationality Based Distribution, which are two instead of seven, and the number of years patients undergo the therapy in the Common Outcome which is eight instead of 28 years.

The quantitative analysis of the binary choices obtained through the pairwise comparisons requires a cardinal measure of the effects of the therapy which I operationalize with the use of quality-adjusted-life-years (QALY), based on the idea that suffering from severe chronic low back pain reduces quality of life. I assume that patients satisfy a discounted utility function based on their quality-adjusted-life-expectancy (QALE) (Sassi, 2006), meaning that a QALY becomes progressively less attractive with time. All patients in the hypothetical scenario are at the same age and are all expected to live for 40 more years[13]. Hence, by replacing the number of years they are expected to live with their QALE, I obtain a continuous measurement of the two possible outcomes in each Lottery and Distribution. This is also obtained in the Common Outcome which offers the therapy to all patients, without uncertainty, for a number of years equal to the expected value of the number of years the therapy is offered in the Lotteries of the respective experimental condition.

The seven Allocation Types can be re-written in terms of QALE as follows. For the *well-off* scenario we have:

- **Lottery** (70%: Treatment for 40 years, 30%: No treatment) takes the form (70%: 32.14, 30%: 21.18)

- **Distribution** (7: Treatment for 40 years, 3: No treatment) takes the form (7: 32.14, 3: 21.18)

- **Common Outcome** (10: Treatment for 28 years) takes the form (10: 29.38)

while, for the *worst-off* scenario we have:

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[13]This is explicitly mentioned in the vignette of the experiment. See Appendix A.

- **Lottery** (20%: Treatment for 40 years, 80%: No treatment) takes the form (20%: 32.14, 80%: 21.18)

- **Distribution** (2: Treatment for 40 years, 8: No treatment) takes the form (2: 32.14, 8: 21.18)

- **Common Outcome** (10: Treatment for 8 years) takes the form (10: 23.98)

The discounted utility function that patients satisfy implies that the sooner the therapy is delivered to them, the better off they are, hence the more they discount time, the more they would prefer the Common Outcome over any of the risky Allocation Types. This difference is more pronounced in the *worst-off* scenario, where a therapy is offered with a smaller probability in the risky Allocation Types and for less years in the Common Outcome, implying a larger difference between the expected discounted utility of the lotteries and the discounted utility of the expected number of years the therapy is offered in the Common Outcome. Importantly enough, this difference between experimental conditions of the difference in patients' utilities between the risky and safe Allocation Type(s) increases with the discount rate [14]. The experimental instructions refrain from any reference to patients' time preferences, thus a very small discount factor is used in the calculations of QALE in Appendix B. Therefore, as long as utilitarian motives imply the maximization of expected QALE, I argue that these are equally endorsed in the treatments of the current online experiment[15].

Table 4 summarizes the measures of inequality and risk of the seven Allocation Types. Pairwise comparisons allow us to disentangle attitudes towards these motives. For instance, Random Distribution is different from any of the Education/Income/Nationality Based Distribution only in terms of ex-ante inequality: in the Random Distribution the social planner does not know upfront who is going to receive the treatment, while in the Education/Income/Nationality Based Distribution the social planner does. Therefore, a preference between these two allocations directly reveals attitudes towards ex-ante inequality (see Example 1 in Section 2). Accordingly, the comparisons between the Random Distribution and Independent and Common Lottery reveal attitudes towards expected ex-post inequality and collective risk as they are similar in terms of ex-ante inequality and individual risk (see Example 2 in Section 2). Finally, comparisons with the Common Outcome show attitudes towards individual risk as this is the only as this is the only Allocation Type that imposes no individual risk.

Note, that these differences would not matter for a social planner who maximizes a utilitarian social welfare function with self-regarding preferences as its arguments. Therefore, he would be indifferent between any two Allocation Types, except for the Common

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[14]Please, see Appendix B for the respective calculations and graphs

[15]Interesting extensions to the current set-up are discussed in Section 6 and formally explained in Appendix B

Table 4: Measures of Inequality and Risk

	Inequality		Risk	
	Ex-ante	Expected ex-post	Individual	Collective
(a) *Well-off*: **(70%:32.14, 30%:21.18)**				
Independent Lottery	0	4.65	5.022	15.88
Common Lottery	0	0	5.022	50.22
Common Outcome	0	0	0	0
Random Distribution	0	5.022	5.022	0
Education Based Distribution	5.022	5.022	5.022	0
Nationality Based Distribution	5.022	5.022	5.022	0
Income Based Distribution	5.022	5.022	5.022	0
(b) *Worst-off*: **(20%:32.14, 80%:21.18)**				
Independent Lottery	0	3.87	4.384	13.86
Common Lottery	0	0	4.384	43.84
Common Outcome	0	0	0	0
Random Distribution	0	4.384	4.384	0
Education Based Distribution	4.384	4.384	4.384	0
Nationality Based Distribution	4.384	4.384	4.384	0
Income Based Distribution	4.384	4.384	4.384	0

Outcome (Rohde and Rohde, 2015). Hence, the experimental set-up of pairwise comparisons allows us to test against this hypothesis: a strict preference for one Allocation Type over the other would indicate that social planners are not disregarding the four motives of ex-ante inequality, ex-post inequality, individual risk and collective risk used in the conceptualization of public risks (Rohde and Rohde, 2015).

3.2   Remarks

The selection of severe chronic low back pain as the confronted disease is motivated by concerns of transparent communication and homogeneous understanding of its effects which were clearly stated in the description of both hypothetical scenarios. It is a disease that is not only relatively common among many (young) people, but also has physical and mental effects that can easily be described to and thought of by the participants without leaving much space for misinterpretations. Furthermore, nerve block therapies are chosen because they can effectively eliminate the effects of severe chronic low back pain only as long as patients undergo the therapy, thus being able to reduce its effectiveness by manipulating the treatment period, holding the benefits patients enjoy under all Allocation Types constant. This is useful because it enhances the comparability of the Common Outcome with the rest of the allocations by equalizing the expected payoffs of all Allocation Types in a neat way by offering a therapy that yields the exact same benefits to all the recipients.

In each scenario, the same seven Allocation Types are presented in pairwise comparisons in randomized order. Hence order effects are eliminated when each respondent indicates his or her preferences in 21 Question Types (QT). Table 4 presents for each experimental condition, the inequality and risk measures associated with each Allocation Type. Note that the values in this table represent standard deviations (as explained in Section 2) of QALE, while respondents in the experiment were presented with the actual amount of years a patient is going to receive the treatment in each allocation. Therefore, the information provided in the questionnaire is easily comprehensible by the respondents, while the values of the inequality and risk concepts of each allocation incorporate the difference in quality of life between a patient who receives the treatment and the one who does not. By keeping individual expected values constant and not allowing the decision maker to derive utility from differences in the expected value of the Allocation Types, I ensure that preferences are driven solely by differences in these values. Alternative explanations are further eliminated by referring to patients who are all at the same age and who all share the same life expectancy.

Among the seven Allocation Types, three of them are deterministic in nature in the sense that they favor patients lower income, higher education and Dutch nationality. This type of allocation is inspired by the experiment of Rohde and Rohde (2015), where the deterministic allocation favours those participants in the experiment whose sum of all digits of their student ID number ranks among the lowest ones. This allocation procedure favours a randomly selected, but predetermined number of participants, where the nature of the ex-ante criterion remains neutral in order not to arouse any additional emotions. The allocation procedures considered in this study purposefully abstract from this type of neutrality in order to test to what extent ex-ante inequality aversion observed in the experimental data of Rohde and Rohde (2015) extrapolates in a different setting where particular groups of the society are favoured in an attempt to evaluate the tradeoff between equality of opportunity and solidarity in the presence of uncertainty, when patients from a higher or lower socioeconomic status are favoured by the chosen policy.

The research design of this study allows the investigation of several interaction effects between attitudes towards inequality and risk and the amount of resources a social planner has available for redistribution. Furthermore, I ask participants to indicate their gender, political orientation and whether they suffered from severe low chronic back in pain in the past. Thereby, I am able to perform a series of heterogeneity tests to explore the magnitude and significance of the corresponding interaction terms.

3.3 Responses

The survey was distributed (mainly) to students of Erasmus University Rotterdam through the online platform of Facebook. During a period of 8 days, 89 individuals (49 in the *well-off* and 40 in *worst-off* scenario) answered all QT, out of the 115 individuals

(64 in *well-off* and 51 in *worst-off* scenario) who participated in the experiment in total. In the *well-off* condition, 24 females and 35 males participated in total (5 did not answer this question), while 21 females and 28 males answered all QT. In the *worst-off* scenario, 26 females and 22 males participated in total (3 did not answer this question), while 21 females and 19 males answered all QT. The median age is 25 years in both experimental conditions, while the average age is 26.6 years in the *well-off* condition and 25.4 years in the *worst-off* one. Table 5 provides an overview of the background characteristics of the participants in the experiment.

Table 5: Background characteristics of participants in the experiment

	All responses	*well-off*	*worst-off*
	$n = 89$	$n = 49$	$n = 40$
Age	26.11 (5.3)	26.65 (6.23)	25.45 (3.84)
Gender (% of males)	52.81%	57.14%	47.5%
Political orientation (%)			
•Extreme Left	5.81%	8.33%	2.63%
•Left – Center	34.88%	33.33%	36.84%
•Center	44.19%	41.67%	47.37%
•Center – Right	15.12%	16.67%	13.16%
•Extreme Right	0%	0%	0%
Affected by chronic low back pain in the past (%)	20.22%	22.45%	17.5%

Note: The table presents the mean age of the participants with standard errors in brackets.

4 Analysis

The preference for one Allocation Type over the other in the 21 QT is driven by differences in inequality and risk scores. In order to maintain the desirable properties of this controlled environment and to prevent differences in the expected utilities of lotteries and distributions between the two experimental conditions to confound our results, the first stage of the analysis separates between the two.

I analyze the data using both non-parametric and parametric tests. First, non-parametric tests are employed in order to test against the hypothesis that respondents in the questionnaire favor a Utilitarian social welfare function with self regarding preferences as inputs. Next, I employ a logistic regression model where the choices indicated in the pairwise comparisons serve as the outcome variable. Here, I estimate the relative importance of each motive and test whether it is statistically significantly associated with

preferences over risk allocation procedures. Furthermore, I pool the observations from the two experimental conditions together in order to test the robustness of the logit estimates against changes in the amount of money social planners have available for redistribution. I do so by introducing a dummy variable *treatment* which stands for the distinction between the two hypothetical scenarios and the corresponding interaction terms with the four motives. Finally, I conduct a series of heterogeneity tests with the inclusion of several interaction terms in the model, where I test whether attitudes towards inequality and risk interact with social planners' political orientation, gender and past experiences with problems of chronic low back pain.

4.1 Binomial Test

For each QT, the distribution of choices between Option A and Option B is given for each experimental condition separately. If subjects maximize a Utilitarian social welfare function with self regarding preferences as inputs, they should be indifferent between the Lotteries and Distributions in the 21 pairwise comparisons as they both yield the same expected utility. I test this with a binomial test.

The individual choice between Option A and Option B is the experimental response variable. Without any loss of generality, let π be the probability of choosing Option A (i.e. the probability of success) for a given individual choice. Also, let S be the number of subjects choosing Option A out of n independent and identical Bernoulli trials, where a trial is defined as an individual response to a particular question. S follows a binomial distribution with index n and parameter π. It follows that the probability of outcome s for S equals:

$$P(s = S) = \frac{n!}{S!(n - S)!} \pi^S (1 - \pi)^{n-S} \qquad \forall S \in [0, n]$$

Responses are analyzed for each experimental condition separately, hence for the *well-off* scenario $n = 49$, while $n = 40$ in the *worst-off*. I repeat the test for each of the 21 QT to test the hypothesis that social planners in the questionnaire exhibit Utilitarian preferences with self regarding preferences as inputs. If this is the case, they should be indifferent between Option A and Option B since they both yield the same expected utility. Therefore, under the null hypothesis, the probability of success π is 0.5. The argument is further established by randomizing the order in which Option A and Option B are presented. All subjects replied to 21 questions, hence:

$$X \sim B(n, \pi)$$

where

$$H0_1: \pi = 0.5$$

$$Ha_1: \pi \neq 0.5$$

4.2 Combinations of attitudes towards inequality and risk

The research design of the online experiment enables us to circumvent the interdependencies of inequalities and risks, hence the outcomes of the binomial tests can be used to extract attitudes towards those motives: significance indicates aversion or seeking towards the motives that drive the respective choices, while insignificance indicates indifference [16]. The three possible attitudes towards each of the four motives make for a total of $3^4 = 81$ possible theoretical combinations. Under the assumption that decision makers exhibit consistent attitudes in the sense that if they are averse, seeking or neutral in any motive in one QT, they are so in all others, I am able to utilize their responses in order to extract a set of possible combinations that do not violate their preferences.

To illustrate the method, consider the comparison between either of the Income/Education/Nationality Based Distribution and the Random Distribution. These allocations differ only in terms of ex-ante inequality (see Table 4). A preference for the Random Distribution (observed in the comparison with Education/Nationality Based Distribution) is therefore interpreted as aversion towards ex-ante inequality while indifference (observed in the comparison with Income Based Distribution) means that social planners are ex-ante inequality neutral.

Similarly, a preference for the Independent Lottery over the Common Lottery is consistent with only two combinations of attitudes towards expected ex-post inequality and collective risk, since ex-ante inequality and individual risk are the same:

- expected ex-post inequality seeking and collective risk averse, neutral or seeking

- expected ex-post inequality averse or neutral and collective risk averse.

To see why, notice that the Independent Lottery yields larger expected ex-post inequality and lower collective risk than the common Lottery, hence, a preference for the former over the later can be driven either by expected ex-post inequality seeking, or collective risk aversion, or both[17]. Note that it is sufficient for *either* one of the two to be satisfied. Similarly, the comparisons of the Common Lottery with the Independent Lottery and Random Distribution are analyzed in the exact same way and reveal attitudes towards expected ex-post inequality and collective risk, as they are different only with respect to these motives. Finally, the comparison of the Common Outcome with the Random Distribution reveals attitudes towards individual risk.

In order to preserve the internal validity and consistency of the preferences indicated by our subjects in the online experiment, I analyze their responses in separate sub-groups.

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[16]Note that subjects in the experiment were not allowed to be indifferent between allocation procedures. The attitudes are obtained through the outcomes of the binomial tests, hence they should be interpreted as on average attitudes of those who participated in the online experiment.

[17]We should not rule out the possibility that one attitude hints towards the preferred allocation, while the rest are favouring the other because the observed preference might be the result of a non-uniform distribution of relative weights between the conflicting attitudes. The relative importance of inequality and risk is obtained with the use of logistic regressions in a later stage of the analysis

First, I distinguish between experimental conditions. In the *well-off* scenario, social planners are in the advantageous position to allocate the therapy to more patients than those in the *worst-off* scenario, a feature that may act as a moderator of attitudes towards inequality and risk[18]. Second, I derive patterns consistent with ex-ante inequality aversion and ex-ante inequality neutrality, in separate subgroups: one containing all QT except for those ones including either the Education or the Nationality Based Distribution and one that includes all QT except for those referring to the Income Based Distribution. To see why, consider the inconsistent attitudes towards ex-ante inequality across the three deterministic allocation: as the preference for the Random Distribution over the Education and Nationality Distribution indicates, subjects are ex-ante inequality averse in the sub-sample of QT excluding the Income Based Distribution, while they are neutral towards ex-ante inequality in the sub-sample of QT excluding the Education and Nationality Based Distribution, as the indifference between the Random Distribution and the Income Distribution indicates (see Table 6). A total of four sub-groups emerge and the possible combinations of attitudes is obtained for each subgroup separately.

4.3 Logistic Regression

To see which of the possible combinations of attitudes is most consistent with the data and to assess the relative importance of each inequality and risk motive, I employ a logit model. For every allocation type $a \in [1,7]$, let $ante_a$, $post_a$, ind_a, $coll_a$ denote its ex-ante inequality, ex-post inequality, individual risk and collective risk scores respectively. I assume that the evaluation of every allocation a is based on the weighted sum of (dis)utility generated by each motive. For each one of the four factors I assume diminishing sensitivity: the marginal return of one unit change in any of the inequality and risk measures decreases with their values. The value that individual i, $i \in [1,89]$, derives by choosing allocation a is given in the form of the following utility function[19]:

$$V_{i,a} = \beta_{ante} ln(1 + ante_a) + \beta_{post} ln(1 + post_a) + \beta_{ind} ln(1 + ind_a) + \beta_{coll} ln(1 + coll_a) + \epsilon_{i,a} \quad (1)$$

where, $\epsilon_{i,a}$ is the individual i and allocation a specific specific error.

Let $b \in [1,7]$ denote the allocation presented to individual i as an alternative option to allocation a. Also, let Y_i be the individual i response variable. If $V_{i,b} > V_{i,a}$ individual i derives higher utility by choosing allocation b over allocation A, $\forall i \in [1,89]$ & $\forall a, b \in [1,7]$. In our General Linear Model (GLM), this is denoted by $Y_i = 1$ (the probability of success).

Every GLM consists of 3 components: the *random component*, the *systematic component* and the *link function*. The random component of our model is the set of observations $Y_i : (Y_1, \ldots, Y_i)$. The systematic component specifies the set of explanatory variables which

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[18]Note that at a later stage in the analysis observations from the two experimental conditions are pooled together and moderation effects are estimated with the relevant interaction terms.

[19]Rohde and Rohde (2015) use the same utility function but they restrict $\epsilon_{i,a}$ to individual specific error.

are those determining individual utility in equation (1). Due to the fact that our response variable is categorical that follows the binomial distribution, we cannot regress $E[Y]$ on the above specified systematic component. Instead, we need a link function. The most appropriate link function when the response variable is a probability (i.e. $E[Y_i]$ takes values between 0 and 1) is the *logit* link function. Our logistic regression model takes the following form:

$$logit[P(Y_i = 1)] = log[\frac{P(Y_i = 1)}{1 - P(Y_i = 1)}] = VD_{i,q} \tag{2}$$

where,

$$VD_{i,q} = V_{i,b} - V_{i,a}$$

and $q \in [1, 21]$ represents a particular QT with b and a indicating the different risk allocation procedures that correspond to each q. It follows, that:

$$VD_{i,q} = \beta_{ante}[ln(1 + ante_b) - ln(1 + ante_a)] + \beta_{post}[ln(1 + post_b) - ln(1 + post_a)] +$$
$$+\beta_{ind}[ln(1 + ind_b) - ln(1 + ind_a)] + \beta_{coll}[ln(1 + coll_b) - ln(1 + coll_a)] + \epsilon_{i,q}$$

where, $\epsilon_{i,q}$ is the individual and question-type specific error term.

Equation (2) implies that $P(Y_i = 1)$ increases or decreases as an S-shape function with the difference in the utility levels allocations a and b yield for individual i.

I define four independent variables as follows:

- $ante_q = ln(1 + ante_b) - ln(1 + ante_a)$: The difference between the logarithms of ex ante inequality scores of allocation b and a.

- $post_q = ln(1 + post_b) - ln(1 + post_a)$: The difference between the logarithms of ex post inequality scores of allocation b and a.

- $ind_q = ln(1 + ind_b) - ln(1 + post_a)$: The difference between the logarithms of individual risk scores of allocation b and a.

- $coll_q = ln(1 + coll_b) - ln(1 + coll_a)$: The difference between the logarithms of collective risk scores of allocation b and a.

where, $q \in [1, 21]$.

It follows, that:

$$VD_{i,q} = \beta_{ante}ante_q + \beta_{post}post_q + \beta_{ind}ind_q + \beta_{coll}coll_q + \epsilon_{i,q} \tag{3}$$

Note, that the independent variables above are defined in the same way irrespective of the actual choice of individual i: even when $Y_i = 0$ so that individual i chooses allocation

a over allocation b, such that $V_{i,a} < V_{i,b}$, the differences remains the same. To the extent that differences in the inequality and risk scores between allocation b and allocation a increase, decrease or do not affect the probability that individual i chooses allocation b, attitudes to the corresponding motives are characterized as averse, seeking or neutral, respectively.

Exponentiating equation (1), we get that the probability that individual i prefers allocation b over allocation a is given by:

$$P(Y_i = 1) = P(VD_{i,q} > 0) = P(V_{i,b} > V_{i,a}) = \frac{exp(VD_{i,q})}{1 - exp(VD_{i,q})}$$

4.3.1 Double clustering

So far, our model assumes the consistent evaluation of inequality and risk motives across allocations a and b. This allows us to estimate the explanatory power of differences in the corresponding motives between allocations a and b and to interpret these estimates as attitudes towards inequality and risk by using them in social planners' utility function (1). However, if social planners evaluate differences between inequality and risk subjectively and inconsistently across QT, their assessments of the seven Allocation Types will be heterogeneous and it would not be appropriate to use the logit estimates in the individual utility function (1). The possibility that the options available to the decision maker can have an effect in his choices has been described by Sen (1997) as 'menu-dependence' and even though this particular type of inconsistency has not been explicitly described by Sen (1997), it certainly belongs to the class of inconsistencies decision makers exhibit due to alternations in the set of alternative options. Indeed, as Stewart et al. (2003) shows, choices under risk can be moderated by the set of the options available to the decision maker. If this is the case, observed (i.e. scores of inequality and risk) differences between allocations a and b are replaced with unobserved (i.e. the emotions that each allocation procedure triggers to the social planner) differences when they are evaluated by social planners. The menu-dependence effect may work as follows: if differences in terms of inequality and risk between allocations a and b are deemed as irrelevant by the social planner, she will instead make a decision based on other more easily available to her criteria specific to the particular QT and which are unobserved by our model. Thus, she would be substituting relevant to our model but missing to her information with less relevant to our model but available to her information (Bos, 2001; Bos, 2003). Thereby, to the extent the comparison between allocations a and b makes the social planner substitute observed with unobserved differences[20] between the two due to the emotions that these allocation procedures trigger, choices within QT will be correlated.

To illustrate the point, consider the comparison between the Income Based Distribution and the Random Distribution, and the comparison between the Education Based

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[20]In the sense that they are accounted for, or not, by our model.

Distribution and the Random Distribution. In terms of the observed differences, the two comparisons are equivalent to each other. However, it is very likely that the nature of the deterministic allocation which is an unobserved factor by our model drives the choices of social planners. If this is the case, choices within QT will be correlated due to the substitution of observable differences with unobservable ones which has been described in the literature as a fairness heuristic (Bos, 2001). It not unlikely that social planners in our experiment indicated their most preferred risk allocation rule based on unobserved QT specific characteristics, thus it is necessary that our model accounts not only for interdependencies within individuals, but also within QT.

Let us relax the assumption of consistent attitudes across risk allocation procedures and account for inconsistent evaluations of differences in inequality and risk scores across QT. It follows that $\epsilon_{i,q}$ captures not only differences in the behaviour between individuals, but also differences in the behaviour of a given individual across QT, which translates to inconsistent attitudes towards inequality and risk across allocations a and b since both a and b appear in more than one, but not all, pairwise comparisons. I postulate the existence of a QT specific error term to capture this type of inconsistency by rewriting the utility function social planners derive from their choices as follows:

$$VD_{i,q} = \beta_{ante}ante_q + \beta_{post}post_q + \beta_{ind}ind_q + \beta_{coll}coll_q + (\epsilon_q + \epsilon_i) \tag{4}$$

where ϵ_q captures differences in the behavior of individuals across QT, or in other words, inconsistent attitudes across allocation procedures[21].

In the context of our model, inconsistent attitudes will manifest themselves as a gap between actual and perceived differences in inequality and risk scores between allocations a and b, caused by unobserved factors that correlate with any of the four motives: given a particular motive, if individuals over/under estimate its value in any of the allocations a or b, they will perceive the actual difference as lower/larger. This gap underlies the aggregate error term, while its two components can be seen as two distinct sources of bias with the potential to inflate this gap.

If the perceived value of each motive (β) is different across individuals i, in the sense that (some) social planners over/under estimate actual differences, there must be an individual specific characteristic driving their preferences. Accordingly, if the perceived value of each motive (β) depends on QT q, in the sense that social planners over/under estimate actual differences in some QT, there must be a QT specific characteristic driving

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[21]This distinction is highly relevant to the implications of social choice theory in policy making as preferences of impartial spectators can be neither decisive nor morally clear if attitudes towards inequality and risk motives, which ought to approve or disapprove policies that allocate risk in society, interact with the alternative options available beyond differences in inequality and risk. In practice, inconsistent and context (in the sense of what the other available options are) dependent preferences reject the existence of a universally fair and acceptable attitude towards inequality or risk and highlight other, difficult to answer, questions regarding the moral acceptability, hence policy relevance, of impartial spectators' distributive preferences. The aim of this analysis is modest as it merely investigate the existence of such biases.

preferences in these pairwise comparisons. The former implies high correlation of choices within individuals, while the later indicates high correlation of choices within QT. Both sources of bias can severely undermine the significance of the logit estimates: if choices are interdependent within individuals (QT) due to individual (QT) specific characteristics (miscalculations), the independence of observations across QT (individuals) is violated, so that the usual maximum likelihood method for estimating standard errors is not valid in the absence of appropriate stratification (Jayatillake, Sooriyarachchi, and Senarathna, 2011) as it will either increase (Moulton, 1990) or decrease (Angrist and Pischke, 2010) the resulting variance of the estimators, thus it will either suppress or inflate the standard errors. I utilize two estimation models where standard errors are clustered at the individual level as well as at both individual and QT level (Cameron, Gelbach, and Miller, 2011). Hence, I am able to obtain robust standard errors by accounting for correlations in error terms both within individuals and within QT (Yoo, 2017). Changes in the standard errors after clustering at both levels will signal correlation between QT unobserved factors and the explanatory variables of the model, hence the comparison of the two models will provide us with evidence on how the nature of the deterministic allocation and the emotions that it triggers, or any other QT specific unobserved characteristic correlates with differences in inequality and risk scores.

4.4 Robustness Check and Heterogeneity Analysis

I test whether the logit estimates of the above model specification are robust towards a change in the expected utility of the lotteries. I do so by pooling the observations from the two experimental conditions together and running logit models which include the relevant dummy variable and the corresponding interaction terms with the four motives. Therefore, I account for differences in the amount of resources the social planner has available for redistribution and differences in the probability for a patient to receive the treatment of nerve block therapies, while being able to statistically test differences in attitudes towards inequality and risk across the two experimental conditions.

In addition, I perform a series of heterogeneity analysis with the inclusion of control variables that account for individual differences in gender, political beliefs and past experiences with chronic low back pain. I specify models with clustered standard errors at the individual and at both the individual and QT level. Below I present equations with standard errors clustered at both levels.

$$VD_{i,q} = \beta X_q + \zeta C_i + (\epsilon_q + \epsilon_i) \tag{5}$$

$$VD_{i,q} = \beta X_q + \gamma D_i + \delta (D * X)_{i,q} + (\epsilon_q + \epsilon_i) \tag{6}$$

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$$VD_{i,q} = \beta X_q + \gamma D_i + \delta(D * X)_{i,q} + \zeta C_i + (\epsilon_q + \epsilon_i) \tag{7}$$

where X_q is the set of four independent variables representing differences in inequality and risk between risk allocation procedures a and b, C_i is a set of dummy variables controlling for gender, political orientation and past experiences with chronic low back pain and D_i is a dummy variable that takes value one if the individual was at the *well-off* scenario and value zero if she was at the *worst-off* scenario.

On top of the above specifications, I construct models where we allow for the interaction of each of the control variables C with the independent variables X:

$$VD_{i,q} = \beta X_q + \zeta C_i + \delta(C * X)_{i,q} + (\epsilon_q + \epsilon_i) \tag{8}$$

Interaction effects in models with a binary dependent variable do not follow the intuition of linear models and the evaluation of its magnitude and statistical significance depends on the values of the rest of the covariates in the model and therefore varies across different levels of the predicted probability of success. Hence, it requires the calculation of the cross-partial derivative of the expected value of the dependent variable with respect to the interacted terms (Ai, Norton, and Wang, 2004)[22]. For these reasons, interaction effects were plotted across the different levels of the covariates, but in order to preserve parsimony in the presentation of the results, unless there is significant heterogeneity in their significance and sign, the logit coefficients and p-values will be treated as a summary measure of the corresponding effects.

5 Results

5.1 (Majority) Preferences over risk allocation procedures

The outcome of the binomial tests are presented in Table 6 for each treatment separately. For preferences to be driven solely by concerns towards inequality and risk, observations from the two experimental conditions should not be pooled together because differences in the expected value of lotteries and distributions across treatments will act as alternative explanations of our results.

In the majority of pairwise comparisons the null hypothesis of social planners maximizing a Utilitarian welfare function with self-regarding utilities as inputs is rejected at a high significance level and our participants seem to be indifferent between two Allocation Types only in very few QT. These results replicate the findings of Rohde and Rohde

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[22]The Stata command *inteff* is used which allows for a more accurate inspection of a possibly heterogeneous and conditional upon the probability of success ($P(Y_i = 1)$) effect.

Table 6: Preferences over Allocation Types

Question Type	Option A	Option B	A	B	p-value
Well-off (n=49): Lottery (70%:21.59, 30%: 14.22), Distribution: (7:21.59, 3: 14.22), Common Outcome (10:17.69)					
1	Independent Lottery	Random Distribution	71%	29%	0.003***
2	Common Lottery	Independent Lottery	37%	63%	0.085*
3	Independent Lottery	EducationBased Distribution	90%	10%	0.000***
4	NationalityBased Distribution	Independent Lottery	14%	86%	0.000***
5	Independent Lottery	IncomeBased Distribution	59%	41%	0.252
6	Common Outcome	Independent Lottery	82%	18%	0.000***
7	Random Distribution	Common Lottery	53%	47%	0.775
8	EducationBased Distribution	Random Distribution	10%	90%	0.000***
9	Random Distribution	NationalityBased Distribution	88%	12%	0.000***
10	IncomeBased Distribution	Random Distribution	49%	51%	1.000
11	Random Distribution	Common Outcome	22%	78%	0.000***
12	Common Lottery	EducationBased Distribution	84%	16%	0.000***
13	Common Lottery	NationalityBased Distribution	82%	18%	0.000***
14	IncomeBased Distribution	Common Lottery	59%	41%	0.252
15	Common Outcome	Common Lottery	86%	14%	0.000***
16	NationalityBased Distribution	EducationBased Distribution	39%	61%	0.152
17	EducationBased Distribution	IncomeBased Distribution	33%	67%	0.021**
18	EducationBased Distribution	Common Outcome	10%	90%	0.000***
19	NationalityBased Distribution	IncomeBased Distribution	20%	80%	0.000***
20	Common Outcome	NationalityBased Distribution	90%	10%	0.000***
21	IncomeBased Distribution	Common Outcome	25%	75%	0.000***
Worst-off (n=40) Lottery (20%:21.59, 80%: 14.22), Distribution: (2:21.59, 8: 14.22), Common Outcome (10:7.18)					
1	Independent Lottery	Random Distribution	73%	27%	0.006***
2	Common Lottery	Independent Lottery	50%	50%	1.000
3	Independent Lottery	EducationBased Distribution	77%	23%	0.000***
4	NationalityBased Distribution	Independent Lottery	17%	83%	0.000***
5	Independent Lottery	IncomeBased Distribution	52%	48%	0.874
6	Common Outcome	Independent Lottery	75%	25%	0.002***
7	Random Distribution	Common Lottery	53%	47%	0.874
8	EducationBased Distribution	Random Distribution	23%	77%	0.000***
9	Random Distribution	NationalityBased Distribution	78%	22%	0.000***
10	IncomeBased Distribution	Random Distribution	50%	50%	1.000
11	Random Distribution	Common Outcome	22%	78%	0.000***
12	Common Lottery	EducationBased Distribution	77%	23%	0.000***
13	Common Lottery	NationalityBased Distribution	77%	23%	0.000***
14	IncomeBased Distribution	Common Lottery	67%	33%	0.038**
15	Common Outcome	Common Lottery	80%	20%	0.000***
16	NationalityBased Distribution	EducationBased Distribution	53%	47%	0.874
17	EducationBased Distribution	IncomeBased Distribution	12%	88%	0.000***
18	EducationBased Distribution	Common Outcome	17%	83%	0.000***
19	NationalityBased Distribution	IncomeBased Distribution	18%	82%	0.000***
20	Common Outcome	NationalityBased Distribution	88%	12%	0.000***
21	IncomeBased Distribution	Common Outcome	33%	67%	0.038***

Note: ***, **, and * denote significance at the 1%, 5%, and 10% level, respectively.

(2015) who conducted an experiment with real monetary incentives, where social planners are asked to distribute real money instead of a hypothetical health treatment[23]. In both experimental scenarios we observe indifference only between the Independent Lottery and Income Based Distribution, Random Distribution and Common Lottery, Income Based

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[23]The only difference between our results and those of Rohde and Rohde (2015) is that social planners in our hypothetical scenario are not indifferent between Common Outcome and Independent Lottery and they significantly prefer the former over the later.

Distribution and Random Based Distribution, Nationality Based Distribution and Education Based Distribution. Moreover, we observe differences between the two conditions in QT 2 and 14. In the *well-off* scenario participants prefer the Independent Lottery over the Common Lottery at 10% significance level, while they are indifferent between these two options in the *worst-off* scenario. Furthermore, and more interestingly, they strictly prefer at a 5% significance level the Income Based Distribution over the Common Lottery in the *worst-off* condition while being indifferent between these two options in the *well-off* one.

For each treatment separately, the preferences of the participants are identified based on majority voting[24] as follows:

- **Well-off:** Common Outcome $\succ$ Independent Lottery $\succ$ Random Distribution $\sim$ Inc.Based Distribution $\sim$ Common Lottery $\succ$ Nat.Based Distribution $\sim$ Ed.Based Distribution

- **Worst-off:** Common Outcome $\succ$ Independent Lottery $\succ$ Inc.Based Distribution $\sim$ Random Distribution $\sim$ Common Lottery $\succ$ Ed.Based Distribution $\sim$ Nat.Based Distribution.

where $\succ$ indicates a statistically significant preference at 5% significance level and $\sim$ represents indifference. Note that preference relations between risk allocation procedures refer to the direct comparisons between these.

We see that Common Outcome is the most popular risk allocation procedure in both scenarios, selected 248 in the *well-off* and 188 times in the *worst-off* scenario, while the least popular one is the Education Based Distribution which was chosen 69 and 58 times, respectively[25]. The popularity of the Common Outcome allocation can be reconciled with individual risk aversion, but it might also be driven by diminishing marginal returns to aggregate life years gained, reflecting social planners' desire to increase the number of beneficiaries at the expense of the magnitude of the benefit itself (Skedgel, Wailoo, and Akehurst, 2015). The Random Distribution is more popular than the Income Based Distribution in the *well-off* scenario and the reverse is true in the *worst-off*. Similarly, Nationality and Education Based Distribution are reversed in order observed across the two experimental conditions. However, as indicated in the binomial tests, our respondents are indifferent between both pairs.

5.2 Attitudes towards inequality and risk

The results of the binomial tests can be used to extract the possible combinations of attitudes towards inequality and risk. To preserve the internal validity of our analysis and

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[24]I derive these patterns by counting how many times each allocation procedure was chosen in total and ranking those in descending order. See Appendix D

[25]Note that 49 individuals filled in the questionnaire in the *well-off* scenario and 40 the *worst-off*. Hence, in total, 1029 and 840 choices were obtained in the *well-off* and *worst-off* scenario, respectively.

the consistency of attitudes across QT, I identify patterns in four sub-samples of QT, as explained in Section 4.2. These consist of QT in the *well-off* and *worst-off* scenario that exclude either the Income or the Education and Nationality Based Distribution.

In the sub-sample of QT that exclude the Education and Nationality Based Distribution, I observe indifference between the Income Based Distribution and the Random Distribution (see Table 6). This preference holds in both experimental scenarios. The only difference between these two allocation types is the ex-ante inequality (see Table 4). Hence, I can conclude that in this sub-sample of QT subjects are ex-ante inequality neutral.

In the sub-sample of QT that exclude the Income Based Distribution, we observe a strict preference for the Random Distribution over the Education and Nationality Based Distribution. This preference holds in both experimental scenarios. The only difference between these two allocation types is the ex-ante inequality. Hence, we can conclude that in this sub-sample of QT subjects are ex-ante inequality averse.

In both experimental scenarios we observe a strict preference for the Independent Lottery over the Random Distribution. These two allocation types differ only in terms of expected ex-post inequality and collective risk: Independent Lottery yields lower expected ex-post inequality and higher collective risk than the Random Distribution. Hence, this preference can be consistent with only two combinations of attitudes towards these motives:

- expected ex-post inequality aversion & collective risk aversion, neutral or seeking

- expected ex-post inequality seeking or neutral & collective risk seeking

In addition, in both experimental scenarios, subjects are indifferent between the Common Lottery and the Random Distribution. These two allocation types differ from each other only in terms of expected ex-post inequality and collective risk: the Common Lottery yields lower expected ex-post inequality and higher collective risk than the Random Distribution. Hence, indifference, can be consistent with only three combinations of attitudes towards these motives:

- expected ex-post inequality aversion & collective risk aversion

- expected ex-post inequality seeking & collective risk seeking

- expected ex-post inequality neutral & collective risk neutral

Consequently, the preference for the Independent Lottery over the Random Distribution and the indifference between the Common Lottery and the Random Distribution, can be consistent either with expected ex-post inequality aversion and collective risk aversion, or expected ex-post inequality seeking and collective risk seeking. The strict preference for the Common Outcome over the Independent Lottery implies that subjects must be

individual risk averse if they are expected ex-post inequality and collective risk seeking, as the Common Outcome yields lower expected ex-post inequality, individual and collective risk than the Independent Lottery, with the two being equivalent with respect to ex-ante inequality. If, on the other hand, subjects are expected ex-post inequality and collective risk averse, their attitudes towards individual risk can be anything, since the preferences for the Common Outcome over both the Random Distribution and the Common Lottery are consistent with any attitude towards individual risk as long as subjects are expected ex-post inequality and collective risk averse.

To summarize, out of the $3^4 = 81$ possible theoretical combinations of attitudes, the following are consistent with the choices indicated in the *well-off* scenario of the online experiment:

In the *well-off* and *worst-off* scenario excluding the Income Based Distribution:

- ex-ante inequality averse - expected ex-post seeking seeking - individual risk averse - collective risk seeking

- ex-ante inequality averse - expected ex-post inequality averse - individual risk averse - collective risk averse

- ex-ante inequality averse - expected ex-post inequality averse - individual risk neutral - collective risk averse

- ex-ante inequality averse - expected ex-post inequality averse - individual risk seeking - collective risk averse

In the *well-off* and *worst-off* scenario excluding the Education and Nationality Based Distribution:

- ex-ante inequality neutral - expected ex-post seeking seeking - individual risk averse - collective risk seeking

- ex-ante inequality neutral - expected ex-post inequality averse - individual risk averse - collective risk averse

- ex-ante inequality neutral - expected ex-post inequality averse - individual risk neutral - collective risk averse

- ex-ante inequality neutral - expected ex-post inequality averse - individual risk seeking - collective risk averse

Note that the above attitudes are the same in both scenarios. Yet, we still observe different preferences in QT 2 and 14 (see Table 6). However, the above combinations of attitudes do not contradict any of these preferences and these differences could be explained by differences in the relative importance of each motive. To see which of the above combinations is most consistent with the data and to assess the relative importance of each motive I now turn to the logistic regression model.

5.3 Relative importance of inequality and risk

The main results of the logit regressions are presented in Tables 7, 8 and 9, for the sub-samples of QT without the Income Based Distribution, without the Education and Nationality Based Distribution and for the full sample of QT, respectively. The tables present estimations for both experimental conditions with standard errors clustered at the individual and at both the individual and QT level, with and without controls, resulting in a total of eight estimation models. Furthermore, the tables consist of two panels. In the first panel all four motives are included, thus accounting for all possible tradeoffs between inequality and risk that inevitably arise in a risky setting where final outcomes are not known ex ante, as explained in Section 2. In the second panel, I present the coefficients of simple logit regressions where only one motive is included at a time.

In the sub-sample of QT excluding the Education and Nationality Based Distribution (Table 7), we see that ex-ante inequality is statistically insignificant in both experimental conditions. We also see that respondents in the *well-off* scenario are ex-post inequality seeking, individual risk averse and collective risk seeking with these attitudes being statistically significant at high significance level (model specifications 1-4). In the *worst-off* scenario, social planners maintain the same attitudes towards individual and collective risk, but the relative importance of ex-post inequality decreases by a factor three and becomes statistically insignificant (model specifications 1-4). Therefore, the obtained coefficients from the logit estimates in this sub-sample of QT are in line with those in Section 5.2, for both experimental conditions .

In the sub-sample of QT excluding the Income Based Distribution (Table 8) we see that respondents in the *well-off* scenario are ex-ante inequality averse, ex-post inequality seeking, individual risk averse and collective risk seeking, with all motives being statistically significant at high significance level (model specifications 1-4). In the *worst-off* scenario, they maintain the same attitudes except from those towards ex-post inequality which are found to be statistically insignificant. Therefore, the logit coefficient in this sub-sample of QT are in line with those derived in Section 5.2, for both experimental conditions. Evidently, the nature of the deterministic allocation influences attitudes towards ex-ante inequality. However, even though social planners in the experiment exhibit some kind of solidarity towards patients with lower income, this willingness should not be translated as a preference for unequal opportunities that favour the disadvantaged. As the indifference between the Independent Lottery and Income Based Distribution indicates in both experimental conditions (Table 6), some of the participants are still in favour of a uniform distribution of opportunities across patients.

Adding a set of control variables in the models (model specifications 5-8) has an effect on collective risk as it loses its statistical significance in the *worst-off* scenario, with the difference being more pronounced in the universe of tradeoffs where attitudes towards ex-ante inequality are neutral, that is in the sub-sample of QT without the Education

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Table 7: Relative Importance of Inequality and Risk in the sub-sample of Question Types without the Education and Nationality Based Allocation

Independent Variables	Estimation Models							
	Well-off		*Worst-off*		*Well-off*		*Worst-off*	
	ID (1)	2-way (2)	ID (3)	2-way (4)	ID (5)	2-way (6)	ID (7)	2-way (8)
β_{ante}	.06	.06	.22	.22	-.09	-.09	.24	.24
β_{post}	.57***	.57***	.14	.14	.55***	.55***	.15	.15
β_{ind}	-1.6***	-1.6***	-1.08***	-1.08***	-1.58***	-1.58***	-1.05***	-1.05***
β_{coll}	.21***	.21***	.17*	.17*	.21***	.21***	.16	.16
ζ_{males}					.08	.08	-.25	-.25
$\zeta_{far\,left}$					-.04	-.04	-1.23***	-1.23***
ζ_{left}					-.19	-.19	.33**	.33*
ζ_{right}					-.09	-.09	.08	.08
$\zeta_{affected}$					.27	.27	-.22	-.22
n	490	490	400	400	480	480	380	380
$Pseudo\_R^2$	.129	.129	0.086	0.086	.128	.128	0.09	0.09
β_{ante}	-.26	-.26	-.11	-.11	-.24	-.24	-.06	-.06
β_{post}	-.35***	-.35	-.35**	-.35	-.35***	-.35	.31**	-.31
β_{ind}	-.95***	-.95***	-.81***	-.81***	-.94***	-.94***	.77***	-.77***
β_{coll}	-.12***	-.12	-0.09	-0.09	-.12***	-.12	-.11	-.11

Note: ***, **, and * denote significance at the 1%, 5%, and 10% level, respectively. Standard errors are clustered at the individual level in model specifications 1, 3, 5 and 7, and at both the individual and QT level in model specifications 2, 4, 6 and 8. Control variables are dummies accounting for differences between males and females, between participants in the far left, left, right and center of the political spectrum and between participants being affected in the past by chronic low back pain and those who did not. Coefficients in the first panel are estimated with all motives included in the model, while coefficients in the second panel are estimated with only motive at a time. The estimated coefficients and significance levels of the control variables in model specifications 5 - 8 are not presented in the second panel as they are the qualitatively similar in magnitude and statistical significance as in the first.

and Nationality Based Distribution (Table 7). If the nature of the deterministic allocation which is an unobserved factor in our model has an effect on attitudes towards collective risk, then we should see a difference in the significance of collective risk between the ID and 2-way clustered estimations in the full sample of QT. Indeed, in Table 9 we see that collective risk becomes insignificant when standard errors are clustered at both the individual and QT level, signaling a correlation between attitudes towards collective risk and unobserved QT specific factors, such as the emotions that the deterministic allocations trigger, or

Table 8: Relative Importance of Inequality and Risk attitudes in the sub-sample of Question Types without the Income Based Allocations

Independent Variables	Estimation Models							
	Well-off		*Worst-off*		*Well-off*		*Worst-off*	
	ID (1)	2-way (2)	ID (3)	2-way (4)	ID (5)	2-way (6)	ID (7)	2-way (8)
β_{ante}	-1.08***	-1.08***	-.71***	-.71***	-1.08***	-1.08***	-.68***	-.68***
β_{post}	.56***	.56***	.11	.11	.53***	.53***	.11	.11
β_{ind}	-1.47***	-1.47***	-.98***	-.98***	-1.44***	-1.44***	-.95***	-.95***
β_{coll}	.19**	.19**	.19**	.19**	.18**	.18**	.18*	.18*
ζ_{males}					-.15	-.15	-.02	-.02
$\zeta_{far\,left}$					-.23	-.23	.29***	.29
ζ_{left}					-.21	-.21	.11	.11
ζ_{right}					.08	.08	-.32	-.32
$\zeta_{affected}$					.18	.18	-.66***	-.66*
n	735	735	600	600	720	720	570	570
$Pseudo\,R^2$	.296	.296	0.189	0.189	.293	.293	.182	.182
β_{ante}	-1.28***	-1.28***	-.98***	-.98***	-1.27***	-1.27***	-.95***	-.95***
β_{post}	-.69***	-.69***	-.69***	-.69***	-.69***	-.69***	-.67***	-.67***
β_{ind}	-1.15***	-1.15***	-1.01***	-1.01***	-1.14***	-1.14***	-.97***	-.97***
β_{coll}	.13***	.13	.24***	.24	.13***	.13	.23***	.23

Note: ***, **, and * denote significance at the 1%, 5%, and 10% level, respectively. Standard errors are clustered at the individual level in model specifications 1, 3, 5 and 7, and at both the individual and QT level in model specifications 2, 4, 6 and 8. Control variables are dummies accounting for differences between males and females, between participants in the far left, left, right and center of the political spectrum and between participants being affected in the past by chronic low back pain and those who did not. Coefficients in the first panel are estimated with all motives included in the model, while coefficients in the second panel are estimated with only motive at a time. The estimated coefficients and significance levels of the control variables in model specifications 5 - 8 are not presented in the second panel as they are the qualitatively similar in magnitude and statistical significance as in the first.

menu dependence effects of the alternative options available. Consequently, attitudes towards collective risk are not necessarily affected by the experimental manipulation, as their change can most likely be attributed to unobserved characteristics specific to the allocation procedures the social planner is able to choose from.

Furthermore, in the full sample of QT, we observe a statistically significant attitude of ex-ante inequality aversion, ex-post inequality seeking and individual risk aversion. One might wonder, weather the significance of ex-ante inequality aversion is the result of the

Table 9: Relative Importance of Inequality and Risk in the full sample of Question Types

Independent Variables	Estimation Models							
	Well-off		*Worst-off*		*Well-off*		*Worst-off*	
	ID (1)	2-way (2)	ID (3)	2-way (4)	ID (5)	2-way (6)	ID (7)	2-way (8)
β_{ante}	-.63***	-.63***	-.40***	-.40**	-.62***	-.62**	-.38***	-.38*
β_{post}	.52***	.52**	.16	.16	.51***	.51*	.16	.16
β_{ind}	-1.37***	-1.37***	-.95***	-.95***	-1.35***	-1.35***	-.91***	-.91***
β_{coll}	.16***	.16	.14*	.14	.16**	.16	.13	.13
ζ_{males}					.01	.01	-.09	-.09
$\zeta_{far\,left}$					-.06	-.06	.26***	.26
ζ_{left}					.03	.03	.13	.13
ζ_{right}					-.09	-.09	-.01	-.01
$\zeta_{affected}$					.16	.16	-.51***	-.51**
n	1,029	1,029	840	840	1,008	1,008	798	798
$Pseudo\,R^2$	.181	.181	.109	.109	.177	.177	.104	.104
β_{ante}	-.82***	-.82***	-.62***	-.62***	-.81***	-.81***	-.59***	-.59***
β_{post}	-.61***	-.61***	-.56***	-.56***	-.60***	-.60***	-.53***	-.53**
β_{ind}	-1.09***	-1.09***	-.94***	-.94***	-1.08***	-1.08***	-.89***	-.89***
β_{coll}	.09***	.09	.16**	.16	.09***	.09	.14**	.14

Note: ***, **, and * denote significance at the 1%, 5%, and 10% level, respectively. Standard errors are clustered at the individual level in model specifications 1, 3, 5 and 7, and at both the individual and QT level in model specifications 2, 4, 6 and 8. Control variables are dummies accounting for differences between males and females, between participants in the far left, left, right and center of the political spectrum and between participants being affected in the past by chronic low back pain and those who did not. Coefficients in the first panel are estimated with all motives included in the model, while coefficients in the second panel are estimated with only motive at a time. The estimated coefficients and significance levels of the control variables in model specifications 5 - 8 are not presented in the second panel as they are the qualitatively similar in magnitude and statistical significance as in the first.

over representation of deterministic allocations associated with ex-ante inequality aversion in the full sample of QT. To test for this, I ran two separate logit regressions in the sub-sample of QT excluding the Nationality Based Distribution and excluding the Education Based Distribution, thus making sure that the two attitudes are equally represented. In both estimations we obtained qualitatively similar results, showing that the results of Table 9 are robust to these considerations.

At first sight, the result of ex-post inequality seeking might look surprising and counter-

intuitive since widely documented evidence from dictator and ultimatum games show aversion to ex-post inequality. However, it is important to realize that in a riskless setting (i.e. typical dictator game) the two notions of inequality coincide and cannot be disentangled. Therefore, the usual finding of ex-post inequality aversion is one that does not account for the tradeoffs between inequalities and risk that naturally arise in the presence of uncertainty (see Example 2). Indeed, as it has been shown by Keeney (1980) and Ben-Porath, Gilboa, and Schmeidler (1997), when collective risk is omitted, collective risk seeking is translated into ex-post inequality aversion. Therefore, when collective risk is not properly accounted for, ex-post inequality aversion could theoretically be the net result of two pure attitudes: collective risk seeking and ex-post inequality seeking (Rohde and Rohde, 2015).

We test this intuition with simple logit regressions where only one motive is included at a time. The results are presented in the second panel (rows 16-19) of Tables 7, 8 and 9, where we can make two observations. First, in the sub-sample of QT excluding the Income Based Distribution (Table 8) we see that the estimated coefficients of ex-ante inequality aversion, individual risk aversion and collective risk seeking are similar to those in the first panel of the table. However, in the absence of the relevant tradeoffs, social planners are averse towards ex-post inequality. This result is a replication in the domain of health of the findings of Rohde and Rohde (2015) who conducted a similar experiment where real monetary payoffs, instead of a hypothetical treatment, are distributed by social planners. It shows that when collective risk is not properly accounted for, collective risk seeking translates into ex post inequality aversion when combined with pure ex post inequality seeking.

Ex-post inequality and collective risk seeking attitudes can be reconciled with the risk-as-feeling hypothesis (Loewenstein et al., 2001) which argues that people evaluate risks both at a cognitive and an emotional level, based on the probability and desirability of the associated consequences and the feelings they trigger. Therefore, the fact that some studies have found collective risk seeking attitudes in situations where individuals have large control over the final outcomes (Rheinberger, 2010), while others have found collective risk averse attitudes in situations over which individuals have little control over the final outcomes (Itaoka et al., 2006), could be explained by the divergence of emotional reactions from cognitive evaluations of the same risks as their determinants differ. That would suggest, in this case, that chronic low back pain is perceived by social planners as a situation over which individuals have some sort of control over it. However, an alternative explanation might also be in place, as responsibility aversion (Leonhardt, Keller, and Pechmann, 2011) could possibly underlie these preferences. This motive refers to individuals' tendency to transfer responsibility to nature and thereby liking risky options, in an attempt to minimize their causal role in the determination of final outcomes. Future research could shed more light on which of the two mechanisms is the most plausible explanation of collective risk and ex-post inequality seeking attitudes, as the available data of the current online experiment do not suffice for this purpose.

The magnitude of the logit coefficients shows the relative importance each motive receives by social planners in the online experiment. In both experimental conditions we observe that individual risk is the most important out of the four, followed by ex-ante inequality, ex-post inequality and collective risk. This ranking holds in all sub-sample specifications, except in the one without the Education and Nationality Based Distribution, where ex-ante inequality receives the least weight out of the four. The absolute value of the coefficients decreases in the *worst-off* scenario, with the one of ex-post inequality being affected the most. An intuitive explanation of this result could be that when the stakes are lower, social planners are less concerned with inequalities and risks.

One possible explanation why the relative weight of collective risk is lower than the one of individual risk is people's disparity in the evaluation of identified versus statistical victims (Jenni and Loewenstein, 1997), since the evaluation of collective risk is based on the dispersion of the total amount of therapies distributed, while the one of individual risk is based on the dispersion of individual probabilities to receive the therapy. The evaluation of these two motives, thus, requires a statistical approach in the case of collective risk and an individual, more personal one, in the case of individual risk. The disparity in the evaluation of the two motives suggests that the social disutility derived from an accident with 100 people involved is less than 10 times the social dis-utility derived from an accident with 10 people involved, which does not contradict the attitude of collective risk seeking. However, the small relative weight of collective risk might also be driven by the fact that the values of collective risk are much larger than the values of individual risk, so that an otherwise equivalent effect is adjusted downwards due to the difference in scales.

Finally, individual and collective risk seem to differ in one more behavioural aspect, since only the relative weight of individual risk decreased in the *worst-off* scenario, where the probability of a patient to receive the treatment shrinks. It is well known that subjects may distort given probabilities and may replace them with subjective evaluations when making choices due to decision weights (Kahneman and Tversky, 1979). This behavioural pattern has been best described with an inverse S-shape function (Prelec, 1998) where small probabilities are over-weighted and large ones are under-weighted, resulting in the so called fourfold pattern of risk seeking in the case of small probabilities and risk aversion in the case of large ones (Kahneman and Tversky, 1979). The decrease in the logit coefficient of individual risk confirms this type of probability weighting, as decision makers in the online experiment were less individual risk averse in the *worst-off* scenario, even though the change is not statistically significant. However, we are not able to observe such a pattern for collective risk attitudes, since its relative weight remains almost the same across the two experimental conditions.

5.3.1 Robustness Check

I run additional logit regressions in the full sample of observations in order to test the robustness of our results against changes in the amount of resources social planners had available for redistribution. The results are summarized in Table 10 and Figure 1.

Table 10: Treatment effects in the full sample of Question Types

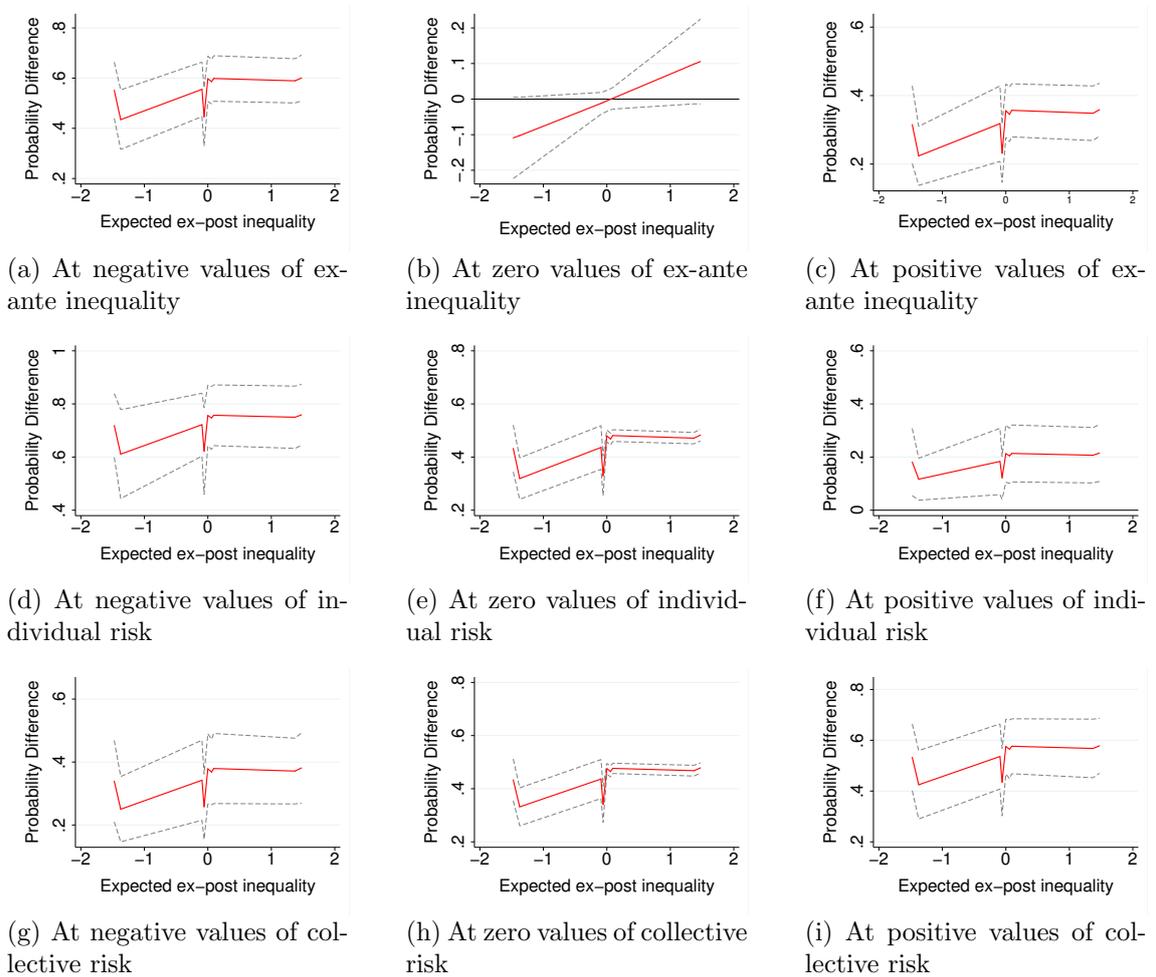| Independent Variables	Estimation Models			
	ID (1)	2-way (2)	ID (3)	2-way (4)
β_{ante}	-.40***	-.40**	-.38***	-.38**
β_{post}	.16	.16	.16	.16
β_{ind}	-.95***	-.95***	-.90***	-.90***
β_{coll}	.15*	.15	.13	.13
$\gamma_{treatment}$	-.02	-.02	-.04	-.04
$\gamma_{treatment*ante}$	-.23	-.23	-.23	-.23
$\gamma_{treatment*post}$	.36*	.36*	.35*	.35*
$\gamma_{treatment*ind}$	-.42	-.42	-.44	-.44
$\gamma_{treatment*coll}$	.02	.02	.02	.02
ζ_{males}			-.02	-.02
$\zeta_{far\,left}$			.06	.06
ζ_{left}			.04	.04
ζ_{right}			-.10	-.10
$\zeta_{affected}$			-.14	-.14
n	1,869	1,806	1,869	1,806
$Pseudo\,R^2$	.149	.141	.149	.141

Note: ***, **, and * denote significance at the 1%, 5%, and 10% level, respectively. Standard errors are clustered at the individual level in model specifications 1 and 3 and at both the individual and QT level in model specifications 2 and 4. The dummy variable *treatment* takes value one for those participants in the *well-off* scenario, and zero for those in the *worst-off*. Control variables are dummies accounting for differences between males and females, between participants in the far left, left, right and center of the political spectrum and between participants being affected in the past by chronic low back pain and not.

The model specifications of Table 10 include the four motives of inequality and risk, a dummy variable that distinguishes between the two experimental conditions and the corresponding interaction terms. The dummy variable is called *treatment*, as it represents

the two experimental conditions, and takes value one for those observations in the *well-off* scenario and value zero for those in the *worst-off* scenario.

We observe statistically significant ex-ante inequality and individual risk aversion, in line with the previous analysis. Moreover, ex-post inequality seeking is statistically insignificant and its interaction with *treatment* is statistically significant at 10% level, whereas collective risk, which is also insignificant, does not interact significantly with *treatment*. These results are not surprising. As we saw before, the relative weight of ex-post inequality was much smaller and statistically insignificant in the *worst-off* scenario, in all model specifications and sub-samples of QT, whereas collective risk seemed to be influenced by QT unobserved factors on top of differences across treatments.

Figure 1: Ex-post inequality treatment effects at different values of ex-ante inequality, individual risk and collective risk.

(a) At negative values of ex-ante inequality

(b) At zero values of ex-ante inequality

(c) At positive values of ex-ante inequality

(d) At negative values of individual risk

(e) At zero values of individual risk

(f) At positive values of individual risk

(g) At negative values of collective risk

(h) At zero values of collective risk

(i) At positive values of collective risk

As explained in Section 4, interaction effects in non-linear models can be highly heterogeneous across different levels of the covariates. Therefore, we investigate the interaction between ex-post inequality and *treatment* at different levels of ex-post inequality and for different values of the rest of the covariates in the model, that is ex-ante inequality, indi-

vidual risk and collective risk. We present the results in Figure 1, which consists of nine sub-figures summarizing the interaction effect at nine selected values of the covariates[26]: extreme negative, zero and extreme positive values of ex-ante inequality, individual risk and collective risk. In each sub-figure I plot the difference in predicted probabilities for different values of ex-post inequality (red line) with the corresponding confidence intervals (grey dashed line) with errors clustered at both the individual and QT level[27].

Two remarks stand out here. First, the interaction effect is positive and significant across the whole range of expected ex-post inequality values and at almost all levels of the covariates, suggesting that social planners are more expected ex-post inequality seeking in the *well-off* scenario than in the *worst-off*. Second, when ex-ante inequality is zero, differences in the predicted probabilities across treatments are statistically insignificant. This is a very interesting observation, suggesting that differences in attitudes towards ex-post inequality across states of the world with unequal amount of resources available for redistribution are closely related to ex-ante inequality: wealth levels do not influence social planners' attitudes towards ex-post inequality when the options available are not different in terms of ex-ante inequality.

These results are in line with the differences we observe (Table 6) in the choices social planners made in QT 2 where they strictly preferred the Independent Lottery over the Common Lottery in the *well-off* scenario, while they were indifferent between the two in the *worst-off*. These two Allocation Types are different only in terms of ex-post inequality and collective risk and, as we see in Table 9, the relative weights of these two motives become roughly equal in the *worst-off* scenario due to the large and statistically significant decrease in the coefficient of ex-post inequality.

5.3.2 Heterogeneity Analysis

Several studies have shown that distributive preferences are highly heterogeneous (Online Appendix B of Rohde and Rohde (2015)). Using a double clustering estimation technique we showed that attitudes towards collective risk are vulnerable to allocation specific characteristics other than the levels of inequality and risk they entail. In this subsection, I will explore individual heterogeneity of attitudes towards inequality and risk. I estimate logit regressions in which I include dummy variables for gender, political orientation and past experiences with chronic low back pain together with the corresponding interaction terms. The results are presented in Tables 11, 12 and 13.

Gender effects are presented in Table 11. Men and women seem to have similar attitudes towards inequalities and risks. The only interaction term that is statistically significant at 10% significance level is the one of individual risk, suggesting that men are

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[26]Note that the covariates of the logit model are differences in inequality and risk scores between Allocation Types, not inequality and risk scores of a single Allocation Type.

[27]The results are statistically and qualitatively the same when standard errors are clustered only at the individual level.

Table 11: Heterogeneity analysis of the relative importance of Inequality and Risk: gender effects.

Independent Variables	Estimation Models			
	ID (1)	2-way (2)	ID (3)	2-way (4)
β_{ante}	-.56***	-.56***	-.68***	-.68***
β_{post}	.32***	.32	.45***	.45*
β_{ind}	-1.11***	-1.11***	-1.41***	-1.41***
β_{coll}	.11**	.11	.17**	.17
$\gamma_{treatment}$	-.04	-.04	-.04	-.04
ζ_{man}	.01	.01	-.01	-.01
$\delta_{man*treatment}$	.04	.04	.04	.04
$\delta_{man*ante}$			.21	.21
$\delta_{man*post}$			-.24	-.24
$\delta_{man*ind}$			.53*	.53*
$\delta_{man*coll}$			-.09	-.09
n	1,869	1,869	1,869	1,869
$Pseudo\,R^2$	.150	.150	.148	.148

Note: ***, **, and * denote significance at the 1%, 5%, and 10% level, respectively. Standard errors are clustered at the individual level in model specifications 1 and 3, and at both the individual and question type level in model specifications 2 and 4. Gender is represented with the dummy variable *man* that takes value one for males, and zero for females. The dummy variable *treatment* takes value one for those participants in the *well-off* scenario, and zero for those in the *worst-off*.

significantly less individual risk averse than women. This result is in line with previous studies on individual risk attitudes showing that women are more risk averse than men (Eckel and Grossman, 2008).

Political orientation effects were tested in five hypotheses, each one using a different coding scheme to transform the five point categorical variable of political orientation into a set of dummy variables. In particular: attitudes towards inequalities and risks of participants in the center were tested against those of participants positioning themselves in the rest of the linear political spectrum; attitudes of those in the far left were tested against those of participants in the rest of the political spectrum; attitudes of those in the left and far left were tested against those in the center and right of the political spectrum; attitudes of those in the left were tested against those in the right of the political spectrum; attitudes of those in the right were tested against those in the rest of the political spectrum. Out of the five models that were estimated to test the above hypotheses, two stand out,

Table 12: Heterogeneity analysis of the relative importance of Inequality and Risk: political orientation effects.

Independent Variables	Estimation Models			
	ID (1)	2-way (2)	ID (3)	2-way (4)
β_{ante}	-.51***	-.51***	-.57***	-.57***
β_{post}	.23*	.23	.31***	.31
β_{ind}	-.93***	-.93***	-1.19***	-1.19***
β_{coll}	.04	.04	.12**	.12
$\gamma_{treatment}$	.08	.08	-.02	-.02
ζ_{center}	-.08	-.08		
$\delta_{center*treatment}$	.14	.14		
ζ_{right}			-.08	-.08
$\delta_{right*treatment}$			-.01	-.01
$\delta_{center*ante}$	-.06	-.06		
$\delta_{center*post}$	.19	.19		
$\delta_{center*ind}$	-.36	-.36		
$\delta_{center*coll}$	.18*	.18**		
$\delta_{right*ante}$			.21	.21
$\delta_{right*post}$			.00	.00
$\delta_{right*ind}$			.55*	.55**
$\delta_{right*coll}$			-.06	-.06
n	1,806	1,806	1,806	1,806
$Pseudo\,R^2$	.141	.141	.144	.144

Note: ***, **, and * denote significance at the 1%, 5%, and 10% level, respectively. Standard errors are clustered at the individual level in model specifications 1 and 3, and at both the individual and question type level in model specifications 2 and 4. Political orientation is represented with two dummy variables: (i) the dummy variable *center* which takes value one for those participants who positioned themselves in the center of the political spectrum, and zero otherwise; (ii) the dummy variable *right* which takes value one for those participants who positioned themselves in the right of the political spectrum, and zero otherwise. The dummy variable *treatment* takes value one for those participants in the *well-off* scenario, and zero for those in the *worst-off*.

indicating (weak) significance of some interaction terms. These models are presented in Table 12. Estimation models 1 and 2 use a dummy variable coded with one for those

Table 13: Heterogeneity analysis of the relative importance of Inequality and Risk: the effect of past experiences with severe chronic low back pain.

Independent Variables	Estimation Models					
	ID (1)	2-way (2)	ID (3)	2-way (4)	ID (5)	2-way (6)
β_{ante}	-.56***	-.56***	-.55***	-.55***	-.55***	-.55***
β_{post}	.32***	.32	.34***	.34	.34***	.34
β_{ind}	-1.11***	-1.11***	-1.19***	-1.19***	-1.19***	-1.19***
β_{coll}	.12**	.12	.14***	.14	.14***	.14
$\gamma_{treatment}$	.08	.08	.08	.08	.08	.08
$\zeta_{affected}$	.38***	.38**	.37***	.37**	.33***	.33***
$\delta_{affected*treatment}$	-.51***	-.51**	-.50***	-.50**	-.48***	-.48**
$\delta_{affected*ante}$			-.06	-.06	.34	.34
$\delta_{affected*post}$			-.09	-.09	-.11	-.11
$\delta_{affected*ind}$			.35	.35	.65	.65
$\delta_{affected*coll}$			-.12	-.12	.09	.09
$\delta_{treatment*affected*ante}$					-.76**	-.76*
$\delta_{treatment*affected*post}$					-.10	-.10
$\delta_{treatment*affected*ind}$					-.37	-.37
$\delta_{treatment*affected*coll}$					-.12	-.12
n	1,869	1,869	1,869	1,869	1,869	1,869
$Pseudo\,R^2$	.147	.147	.148	.148	.154	.154

Note: ***, **, and * denote significance at the 1%, 5%, and 10% level, respectively. Standard errors are clustered at the individual level in model specifications 1, 3 and 5, and at both the individual and question type level in model specifications 2, 4 and 6. Past experiences with severe chronic low back pain are represented with the dummy variable *affected* which takes value one for those participants who suffered in the past from chronic low back pain, and zero for those who did not. The dummy variable *treatment* takes value one for those participants in the *well-off* scenario, and zero for those in the *worst-off*.

participants in the center and zero otherwise, whereas estimation models three and four include a dummy variable that takes value one for those in the right and zero otherwise. In the first model, the interaction term of collective risk is statistically significant, suggesting that those in the center are significantly more collective risk seeking than the rest, though collective risk is not statistically significant here. This interaction can also explain why collective risk was becoming insignificant in the *worst-off* scenario when control variables were added to the model. The inconsistent influence political orientation has on collective risk raises expectations of a possible interaction effect between the dummy variable *center* and *treatment*, but this does not appear to be the case.

In the second model, individual risk interacts significantly with the dummy variable *right*, indicating that social planners in the right are significantly less individual risk averse than the rest. A word of caution regarding these interactions is necessary for two reasons: first, scores of political orientation should be interpreted as perceived beliefs and not actual ones, since participants in the online experiment were not assessed objectively on their political orientation, but they simply ranked themselves on a five point scale; second, concepts and ideas are subjectively attributed to left and right, these associations being different across individuals and cultures (Mair, 2007). This might explain why interaction effects here are limited to individual and collective risk, instead of ex-ante and ex-post inequality as one would expect.

Finally, I explore to what extent attitudes towards inequality and risk are different between the sub-group of social planners who suffered by chronic low back pain in the past and those who did not. To do so, I include a dummy variable called *affected* which takes value one for those who shared past experiences with the disease and zero for the rest. In all model specifications of Table 13 the dummy variable is statistically significant, indicating that, on average, distributive preferences are statistically significantly different across the two groups. Furthermore, it interacts significantly with *treatment*, suggesting that the impact it has on distributive preferences is not the same across the two experimental conditions. This motivates the inclusion of the four three way interaction terms in order to explore which one of these motives drives this interaction. In model specification 5 and 6 we see that it is ex-ante inequality driving this effect: in the *well-off* scenario, social planners who were affected by chronic low back in the past are more ex-ante inequality averse than those who were not, but they are less so in the *worst-off* scenario. This interaction shows that social planners who are more likely to sympathize with the patients exhibit distributive preferences closer to solidarity[28] when the amount of resources they have available for redistribution decreases. The larger popularity of the Income Based Distribution in the *worst-off* scenario (see Table 14) suggests that such solidarity concerns are motivated by the willingness to favour patients with lower incomes.

6 Discussion

This paper investigated choices over risk allocation procedures of decisions makers whose actions did not affect their own (hypothetical) payoffs. Hence, our analysis is most relevant to situations where impartial spectators, or social planners, decide on behalf of others, such as those when public policy makers decide on behalf of citizens or when employers decide on behalf of their employees. Possible extensions to this analysis include the investigation of distributive preferences under uncertainty of involved stakeholders or even the implementation of a Rawlsian notion of impartiality, where decision makers are

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[28]Note that a stronger preference for solidarity, as it has also been explained in the introduction, implies a willingness to favour a pre-determined group of individuals, which is the opposite of ex-ante inequality aversion.

placed behind the veil of ignorance. This will reveal whether attitudes towards public risk change when decision makers are influenced by their decisions or when a different notion of impartiality is in place.

Impartial preferences were elicited by asking the participants of the online experiment to state their most preferred risk allocation rule of a hypothetical therapy that effectively eliminates the symptoms of chronic low back pain. The results replicated to a large extent the findings of Rohde and Rohde (2015) who employed a similar experimental design with real monetary incentives. Though many studies have investigated distribution preferences in risk-less contexts, few have done so in the presence of uncertainty, hence replication of these findings in different domains is necessary. Possible avenues of future research include the investigation of preferences over risk allocation procedures in the domain of losses, as framing effects may have a major impact on attitudes towards risk and inequality (Tversky and Kahneman, 1981; Bordalo, Gennaioli, and Shleifer, 2012). This is because individual risk aversion might be replaced with risk seeking when the downsides of the options become more salient, and the opposite for collective risk. It is plausible that an extension in the domain of losses might reveal a preference of social planners to maximize a Utilitarian social welfare function with self-regarding preferences as inputs, since highlighting the number of individuals one cannot save reduces the utility of helping (Västfjäll, Slovic, and Mayorga, 2015).

The robustness of the finding that social planners maximize a social welfare function with purely self-regarding preferences as inputs, can be further scrutinized by explicitly introducing stronger time discounting preferences of patients affected by the distribution of the therapy. As I show in Appendix B, the more a patient discounts the future, the more salient the influence of constrained financial resources will be for those impartial spectators who adhere to a Utilitarian notion of fairness. Thus, the analysis of choices across states of the world with unequal levels of wealth and with varying degrees of time preferences, will allow the investigation of interesting interaction effects between impartial spectators' attitudes towards inequality and risk and Utilitarian concerns.

Finally, we saw that attitudes towards collective risk are subject to unobserved allocation specific characteristics which, as the fairness heuristic theory contends (Bos, 2001), make social planners substitute the information that is relevant to our model, but missing to them, with information that is less relevant to our model, but available to them. Of course, our analysis does not permit the identification of such criteria, except from the nature of the deterministic allocation. Future research could shed more light on this type of substitution.

7 Conclusion

The research design of this paper makes it possible to decompose the inequalities and risks associated with each of the seven risk allocation rules social planners were presented

with in an online experiment and allows the analysis to overcome the interdependencies that inevitably occur in the presence of uncertainty. In a unified framework that encompasses the respective tradeoffs between inequalities and risk, logistic regression analysis of binary responses revealed that social planners displayed significant individual risk aversion and a strong preference for an allocation rule that offers a moderate therapy to all patients, without uncertainty. Furthermore, we observed a strong preference to equalize opportunities by offering an independent probability to each patient to receive the treatment. However, ex-ante inequality aversion fades out when participants in the experiment were allowed to favour patients with lower income, in which case we observed indifference towards this attitude. Moreover, I found ex-post inequality seeking and collective risk seeking, with the later attitude being sensitive to allocation specific characteristics. Even though ex-post inequality and collective risk seeking might seem a surprising result, I showed that it does not contradict existing literature.

As there is significant heterogeneity underlying these results, given planners' political orientation and shared experiences with the patients in the hypothetical scenario, lessons for policy recommendations should be drawn with caution. Nevertheless, the analysis suggests that impartial spectators are not indifferent towards ex-ante inequality, ex-post inequality, individual risk and collective risk. Hence, in the distribution of health risk in society, disregarding any of these motives might lead to sub-optimal decisions, as policies should not aim at the maximization of purely self-regarding Utilitarian social welfare functions.

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Appendices

A Experimental instructions

The instructions of the experiment were presented to the participants in blocks, via the online platform Qualtrics, as follows.

Dear participant,

Welcome to this decision making experiment.

It is simple, and it will last approximately 10 minutes.

First, an imaginary scenario will be described to you on which a decision needs to be made on how a potential treatment should be allocated to patients. These allocations will then be explained to you before you indicate your preferences in a choice list of pairwise comparisons. Finally, you will be asked some personal questions.

Your choices are anonymous throughout the whole experiment. There are no wrong or right answers and your honest preferences is what I am interested in with this questionnaire.

If you are ready, turn to the next page.

Imagine that this year the number of patients suffering from severe chronic low back pain with leg pain in The Netherlands has increased and the health ministry decided to take some action to face the problem.

This disease cannot be fully treated without facing significant risks, thus the ministry decided to offer nerve block therapies to the patients. This therapy will effectively improve their health and lifestyle only for the time period during which they undergo the treatment.

Initially, the ministry was willing to offer the therapy to every patient. However, limited financial resources and increased spending in several other programs do not allow the implementation of this policy and a decision needs to be made on how to manage the resources available. In other words, a decision needs to be made on how to allocate the treatment to the patients

The treatment will be implemented to individuals at the age of 42, which is the age group that suffers from this disease the most. The life expectancy of the patients does not change and remains the same whether they receive the treatment or not since this is a non-fatal disease. The overall estimated life expectancy in the Netherlands for men and women is 82 years, which means that patients will die after 40 years, no matter if they receive the treatment or not. Also, the treatment will be offered either for 40 years or less, depending on the amount of resources available for redistribution.

The effect of the treatment is mainly captured in patients' quality of life. Depending on receiving the treatment or not you can think of the following health profiles[a]:

Bad Health with no treatment:

- constant low back pain

- difficulties in everyday activities (sitting, standing, dressing, lifting things up)

- psychological effects caused by poor quality of sleep, worrying and loss of some enjoyment in life

Good Health while undergoing the treatment (nerve block therapies):

- almost no low back pain

- no difficulties in everyday activities (sitting, standing, dressing, lifting things up)

- no psychological effects

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[a]The description of the Good and Bad Health conditions was taken from (Salomon et al., 2015)

The government is considering 7 different allocation procedures.

Imagine that you work at the Health Ministry of the Netherlands and you have to decide on how to allocate the treatment to patients suffering from severe chronic low back pain.

The allocations are described on the next page. You will be asked to indicate your most preferred allocation in pairwise comparisons. You don't have to memorize anything since a short description is given in the choice list later. You only have to understand how the allocation works and the way the treatment is distributed to the patients. You can always go back to read again the description of each allocation while indicating your preferences in the choice list.

Please read the descriptions of the allocations carefully and make sure you understand each one of them before you continue.

Allocation Type 1

The ministry will allocate the resources in such a way that each patient will, independently, have a 70% probability to receive the treatment and 30% probability not to receive any treatment. You can think of the uncertainty being resolved by rolling a special 10-sided dice which is rolled for every patient separately.

For instance, if the first patient, called patient A, receives the treatment, the probability that the second patient, called patient B, receives the treatment does not change and remains 70%. Thus, this allocation can have a different outcome for each patient, meaning that some patients will be in Good Health while some others will continue living with the same disabilities. However, it can still be the case that all or nobody receives the treatment.

The patients who get the treatment, will receive it for 40 years.

Allocation Type 2

The ministry will allocate the resources in such a way that there is a common probability of 70% that all patients will receive the treatment and 30% probability that no patient receives the treatment. You can think of the uncertainty being resolved by rolling a special 10-sided dice which is rolled once and the same outcome applies to every patient.

This means that patients will all be in the same situation, either receiving the treatment and live in Good Health or not receiving the treatment and continue living with the same disabilities.

If patients get the treatment, they will receive it for 40 years.

Allocation Type 3

The ministry will allocate the resources in such a way that 70% of the patients will receive the treatment. The selection is random. For instance, in a group of 10 patients, 7 will receive the treatment and they will be in Good Health, while the remaining 3 will receive no treatment and they will continue living with the same disabilities.

The patients who get the treatment, will receive it for 40 years

Allocation Type 4 - 5 - 6

The ministry will allocate the resources in such a way that 70% of the patients will receive the treatment. Here, the selection is not random and is based on the level of education of each patient. For instance, in a group of 10 patients, 7 will receive the treatment and they will be in Good Health, while the remaining 3 will receive no treatment and they will continue living with the same disabilities. Patients with higher education are given priority.

The same type of allocation is also considered two more times but with a different criterion in place in order to prioritize some patients over the others. In the choice list you will also be able to choose an allocation that gives priority to patients with Dutch nationality or to patients with lower income.

The patients who get the treatment, will receive it for 40 years.

Allocation Type 7

The ministry will allocate the resources in such a way, that every patient receives the same treatment without uncertainty, but for a shorter period of time.

The treatment will be offered to patients for 28 years, instead of 40.

In the next page, you will be presented with a choice list where you can choose your most preferred Allocation Type in pairwise comparisons. All Allocation Types will be considered in a group of 10 people. For each one of the following questions compare the left with the right option and choose one of the two. In total you will make 21 choices.

Remember that there are no wrong or right answers. Please, indicate your true preferences.

Option A

Each patient, **independently**, has 70% probability to receive the treatment, and 30% probability not to receive any treatment.

Option B

Randomly, 7 patients will be selected to receive the treatment, and 3 will not receive any treatment.

Option A

There is 70% **common** probability that all patients will receive the treatment and 30% common probability that all patients will not receive any treatment.

Option B

Each patient, **independently**, has 70% probability to receive the treatment, and 30% probability not to receive any treatment.

Option A

Each patient, **independently**, has 70% probability to receive the treatment, and 30% probability not to receive any treatment.

Option B

Based on their level of education, 7 patients will be selected to receive the treatment while the remaining 3 will not receive any treatment. Higher education patients are given priority.

Option A

Based on their nationality, 7 patients will be selected to receive the treatment while the remaining 3 will not receive any treatment. Dutch patients are given priority.

Option B

Each patient, **independently**, has 70% probability to receive the treatment, and 30% probability not to receive any treatment.

Option A

Each patient, **independently**, has 70% probability to receive the treatment, and 30% probability not to receive any treatment.

Option B

Based on their income, 7 patients will be selected to receive the treatment while the remaining 3 will not receive any treatment. Lower income patients are given priority.

Option A

All patients will receive the same treatment for 28 years instead of 42, **without uncertainty**.

Option B

Each patient, **independently**, has 70% probability to receive the treatment, and 30% probability not to receive any treatment.

Option A

Randomly, 7 patients will be selected to receive the treatment, and 3 will not receive any treatment.

Option B

There is 70% **common** probability that all patients will receive the treatment and 30% common probability that all patients will not receive any treatment.

Option A

Based on their level of education, 7 patients will be selected to receive the treatment while the remaining 3 will not receive any treatment. Higher education patients are given priority.

Option B

Randomly, 7 patients will be selected to receive the treatment, and 3 will not receive any treatment.

Option A

Randomly, 7 patients will be selected to receive the treatment, and 3 will not receive any treatment.

Option B

Based on their nationality, 7 patients will be selected to receive the treatment while the remaining 3 will not receive any treatment. Dutch patients are given priority.

Option A

Based on their income, 7 patients will be selected to receive the treatment while the remaining 3 will not receive any treatment. Lower income patients are given priority.

Option B

Randomly, 7 patients will be selected to receive the treatment, and 3 will not receive any treatment.

Option A

Randomly, 7 patients will be selected to receive the treatment, and 3 will not receive any treatment.

Option B

All patients will receive the same treatment for 28 years instead of 42, **without uncertainty**.

Option A

There is 70% **common** probability that all patients will receive the treatment and 30% common probability that all patients will not receive any treatment.

Option B

Based on their level of education, 7 patients will be selected to receive the treatment while the remaining 3 will not receive any treatment. Lower education patients are given priority.

Option A

There is 70% **common** probability that all patients will receive the treatment and 30% common probability that all patients will not receive any treatment.

Option B

Based on their nationality, 7 patients will be selected to receive the treatment while the remaining 3 will not receive any treatment. Dutch patients are given priority.

Option A

Based on their income, 7 patients will be selected to receive the treatment while the remaining 3 will not receive any treatment. Lower income patients are given priority.

Option B

There is 70% **common** probability that all patients will receive the treatment and 30% common probability that all patients will not receive any treatment.

Option A

All patients will receive the same treatment for 28 years instead of 42, **without uncertainty**.

Option B

There is 70% **common** probability that all patients will receive the treatment and 30% common probability that all patients will not receive any treatment.

Option A	Option B
Based on their nationality, 7 patients will be selected to receive the treatment while the remaining 3 will not receive any treatment. Dutch patients are given priority.	**Based on their level of education**, 7 patients will be selected to receive the treatment while the remaining 3 will not receive any treatment. Higher education patients are given priority.
Based on their level of education, 7 patients will be selected to receive the treatment while the remaining 3 will not receive any treatment. Higher education patients are given priority.	**Based on their income**, 7 patients will be selected to receive the treatment while the remaining 3 will not receive any treatment. Lower income patients are given priority.
Based on their level of education, 7 patients will be selected to receive the treatment while the remaining 3 will not receive any treatment. Higher education patients are given priority.	All patients will receive the same treatment for 28 years instead of 42, **without uncertainty**.
Based on their nationality, 7 patients will be selected to receive the treatment while the remaining 3 will not receive any treatment. Dutch patients are given priority.	**Based on their income**, 7 patients will be selected to receive the treatment while the remaining 3 will not receive any treatment. Lower income patients are given priority.

Option A

All patients will receive the same treatment for 28 years instead of 42, **without uncertainty**.

Option B

Based on their nationality, 7 patients will be selected to receive the treatment while the remaining 3 will not receive any treatment. Dutch patients are given priority.

Option A

Based on their income, 7 patients will be selected to receive the treatment while the remaining 3 will not receive any treatment. Lower income patients are given priority.

Option B

All patients will receive the same treatment for 28 years instead of 42, **without uncertainty**.

That was it.

Now, please, answer the following last questions.

1. What is your gender?

☐ Male.

☐ Female.

2. What is your age?

[ ]

3. What is your nationality?

[ ]

4. What is your completed level of education?

☐ High School degree.

☐ Technical/vocational training degree.

☐ University Bachelor's degree.

☐ University Master's degree.

☐ University Doctorate degree.

5. What is your field of studies? (only applicable to students)?

[ ]

6. Please, rate your political orientation on the following scale from 1 (far left) to 5 (far right).

Far Left ☐—☐—☐—☐—☐ Far Right

7. Did you ever face any kind of disability related to severe chronic low back pain? These include constant low back pain and difficulties in everyday activities (sitting, standing, dressing, lifting things up)

☐ Yes.

☐ No.

B QALE

One of the main use of QALYs is to adjust patient's life expectancy based on his or her health-related quality of life they are predicted to experience throughout the course of their life, or part of it. The number of QALYs lived by an individual in one year are:

$$QALYs\ lived\ in\ one\ year = 1 * Q, \qquad Q \leq 1$$

where Q is the health-related quality of life weight attached to the relevant year of life. It follows, that a patient's quality-adjusted life expectancy (QALE) at age a is:

$$QALE = \sum_{t=a}^{a+L} Q_t$$

where L is the residual life expectancy of the individual at age a, and t represents individual years within that life expectancy range. By including time preferences into the equation, we reach the following:

$$Discounted\ QALE = \sum_{t=a}^{a+L} \frac{Q_t}{(1+r)^{t-a}} \tag{9}$$

where r is the discount rate. Incorporating time preferences in the calculation of QALE allows for decreasing marginal returns of an additional QALY in QALE, so that an additional year of therapy is weighted more the sooner it occurs. For the actual calculations the following values and assumptions replace the parameters: $D = 0.374$, $Q = 1 - D = 0.626$, $Q^i = 0.95$[29], $a = 42$, $r = 0.01$, $L = 40$[30].

Incorporating these into equation (1), we get:

$$Discounted\ QALE\ (no\ therapy)\ = \sum_{t=42}^{82} \frac{0.626}{(1+0.01)^{t-42}} = 21.18$$

$$Discounted\ QALE\ (therapy)\ = \sum_{t=42}^{82} \frac{0.95}{(1+0.01)^{t-42}} = 32.14$$

So that:

$$E[Discounted\ QALE_{well\text{-}off}] = 0.7 * 32.14 + 0.3 * 21.18 = 28.85$$

$$E[Discounted\ QALE_{worst\text{-}off}] = 0.2 * 32.14 + 0.8 * 21.18 = 23.37$$

And since:

$$EV\ (Well - off) = [0.3 * 0 + 0.7 * 40] = 28$$

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[29]Q^i stands for health related quality of life while receiving the therapy.

[30]The values of disability weight for severe chronic low back pain without leg pain and QALY while receiving the therapy are taken from Salomon et al. (2015). The rest follow from choices we made in the construction of the experimental design in order to eliminate threats to internal validity.

$$EV\ (Worst-off) = [0.8*0 + 0.2*40] = 8$$

We have:

$$Discounted\ QALE_{short-term\ therapy\ (Well-off)} =$$

$$= \sum_{t=42}^{70} \frac{0.95}{(1+0.01)^{t-42}} + \sum_{t=71}^{82} \frac{0.626}{(1+0.01)^{t-42}} = 29.38$$

$$Discounted\ QALE_{short-term\ therapy\ (Worst-off)} =$$

$$= \sum_{t=42}^{50} \frac{0.95}{(1+0.01)^{t-42}} + \sum_{t=51}^{82} \frac{0.626}{(1+0.01)^{t-42}} = 7.61 + 10.07 = 23.98$$

The difference between a patient's expected discounted QALE (utility patients receive with the lotteries and distributions) and her QALE of the expected numbers of years they are about to receive the therapy (utility patients receive with the Common Outcome), is 0.53 and 0.61 in the *well-off* and *worst-off* scenario, respectively. If a social planners maximizes a Utilitarian social welfare function with self regarding preferences as inputs, she will prefer the Common Outcome more, the larger these differences are. Since, the difference of the differences is only 0.08 in this experiment we assume that Utilitarian concerns are equally strong in both experimental scenarios. However, with a larger discount rate the difference in a patient's utility between the Common Outcome and the risky allocations will increase. In Figure 2 we show how these differences change at different discount rates where the probability they receive the therapy varies in the interval [0.05, 0.95].

Figure 3, shows in a more clear way how the difference of the differences increases with increasing discount rates. In other words, it shows, how patients' time preferences can be used to experimentally manipulate Utilitarian concerns. A 0.2 and 0.7 probability to receive the therapy in a *worst-off* and *well-off* scenario, respectively, were used to obtain the metrics in Figure 3. It therefore shows that had we used a larger discount rate in the current experiment, Utilitarian concerns would have been much stronger in the *worst-off* scenario. If social planners maximize a Utilitarian social welfare function with self regarding preferences as inputs, their attitudes towards inequality and risk will be more affected by such concerns when the amount of resources available for redistribution decreases, the larger the discount rate.

Note, that changing the probabilities of receiving the therapy in the two scenarios will change the differences in the (expected) utilities between the Lotteries and Common Outcome (Figure 2), as well as the differences of the differences (Figure 3).
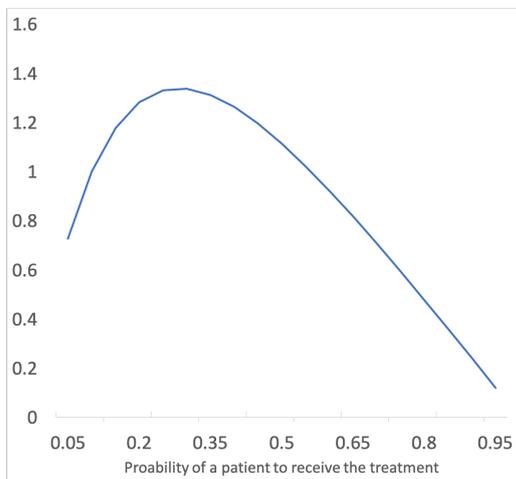
Figure 2: Differences in patients' (expected) utility (measured as discounted QALE) between the Lotteries and the Common Outcome, across different probabilities to receive the therapy, at different discount rates.
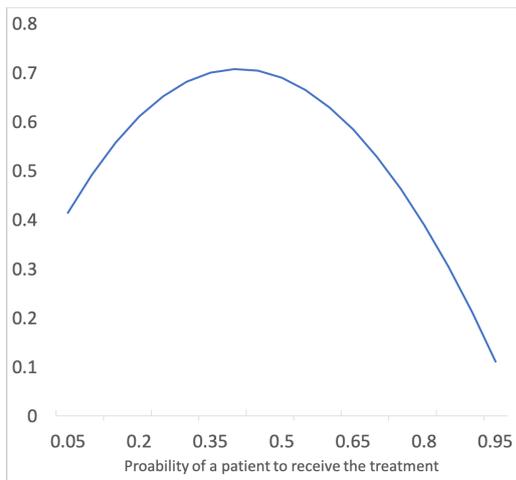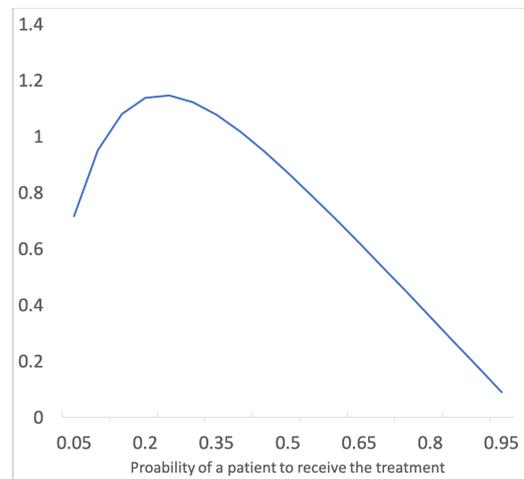

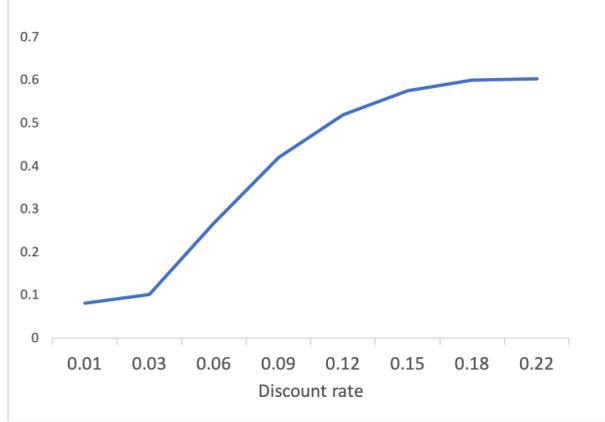(a) $r = 0.01$
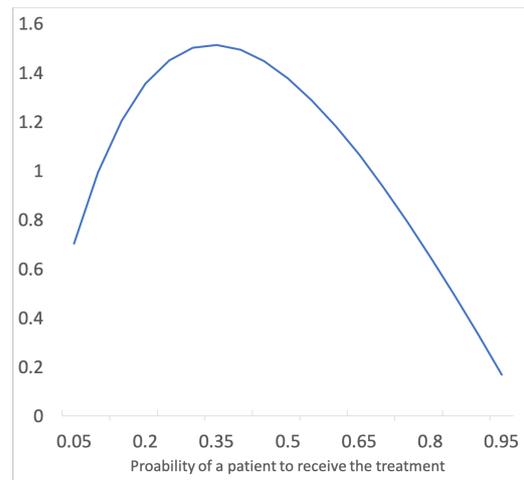
(b) $r = 0.09$

(c) $r = 0.15$

(d) $r = 0.22$

Figure 3: Differences of the differences in patients' (expected) utility (measured as discounted QALE) between the Lotteries and the Common Outcome, across different discount rates.

C   Operationalizing Inequality and Risk: calculations

In this subsection we outline the calculations of the measures of Inequality and Risk as defined in Section 2 and presented in Table 4.

C.1   Common Lottery

In this lottery, we cannot define ex post allocation beforehand since the result of the experiment is yet unknown. However, we know that two ex-post allocations with $n = 10$ can arise: $X = (32.14, ..., 32.14)$ or $X = (21.18, ..., 21.18)$. The ex-ante allocation, then, is $L = ((20\%(32.14, ..., 32.14); 80\%(21.18, ..., 21.18))$. For ex-ante lottery L the possible total payoffs are 211.8 and 321.4.

In the *worst-off* scenario we have:

$$IEV_i(L) = \sum_{j=1}^{m} p_j x_{i,j} = 0.2 * 32.14 + 0.8 * 21.18 = 23.372$$

Every individual i faces the same risk, hence

$$\overline{IEV_i}(L) = \sum_{i=1}^{n} \frac{1}{n} IEV_i(L) = 23.372$$

and

$$EAI(L) = \sqrt{\sum_{i=1}^{n} \frac{1}{n} \left(IEV_i(L) - \overline{IEV}(L)\right)^2} = 0$$

The lottery is resolved only once and there is probability $p = 1$ that all individuals receive the same payoff. The uniformity of the distribution of individual payoffs implies

that the ex-post average payoff will be equal to the individual payoff.

$$EPI(x) = \sqrt{\sum_{i=1}^{n} \frac{1}{n}(x_i - \bar{x})^2} = 0$$

Also,

$$IR_i(L) = \sqrt{\sum_{j=1}^{m} p_j(x_{i,j} - IEV_i(L))^2} = \sqrt{0.2(31.14 - 23.372)^2 + 0.8(21.18 - 23.372)^2} = 4.383$$

Finally,

$$CEV(L) = \sum_{j=1}^{m} p_j\left(\sum_{i=1}^{n} x_{i,j}\right) = 0.2 * 321.4 + 0.8 * 211.8 = 233.4$$

and,

$$CR(L) = \sqrt{\sum_{j=1}^{m} p_j\left(\left(\sum_{i=1}^{n} x_{i,j}\right) - CEV(L)\right)^2} = \sqrt{0.2(321.4 - 233.4)^2 + 0.8(211.8 - 233.4)^2} = 43.84$$

In the *well-off* scenario the exact same steps were followed with probabilities 0.7 and 0.3 replacing 0.2 and 0.8, respectively.

C.2 Random Distribution

In the *worst-off* scenario, the ex-post allocation of the Random Distribution, for $n = 10$, can be any combination of individual payoffs, as long as two individuals end up with 31.14 QALE and eight with 21.18 QALE. The ex-ante allocation is $L = ((20\%(31.14, ..., 31.14); 80\%(21.18, ..., 21.18))$.

Therefore,

$$IEV_i(L) = \sum_{j=1}^{m} p_j x_{i,j} = 0.2 * 31.14 + 0.8 * 21.18 = 23.372$$

Every individual i faces the same risk, hence

$$\overline{IEV_i}(L) = \sum_{i=1}^{n} \frac{1}{n} IEV_i(L) = 23.372$$

and

$$EAI(L) = \sqrt{\sum_{i=1}^{n} \frac{1}{n}(IEV_i(L) - \overline{IEV}(L))^2} = 0$$

Intuitively, since all individuals have the same probability to receive the same outcome, ex-ante inequality is equal to zero.

Since this is a distribution, we estimate ex-post inequality and not expected ex-post inequality since the resulted payoffs are rather defined and not expected.

$$\overline{x} = \sum_{i=1}^{n} \frac{1}{n} x_i = \left(\frac{1}{10} * 31.14\right) * 2 + \left(\frac{1}{10} * 21.18\right) * 8 = 23.372$$

and

$$EPI(x) = \sqrt{\sum_{i=1}^{n} \frac{1}{n}(x_i - \overline{x})^2} = \sqrt{\left(\frac{1}{10}(31.14 - 23.372)^2\right) * 2 + \left(\frac{1}{10}(21.18 - 23.372)^2\right) * 8} = 4.384$$

Individual risk is given by,

$$IR_i(L) = \sqrt{\sum_{j=1}^{m} p_j(x_{i,j} - IEV_i(L))^2} = \sqrt{0.2(31.14 - 23.372)^2 + 0.8(21.18 - 23.372)^2} = 4.384$$

Finally,

$$CEV(L) = \sum_{j=1}^{m} p_j\left(\sum_{i=1}^{n} x_{i,j}\right) = 233.4$$

since outcomes here are standard: $2 * 31.14 + 8 * 21.18$
Thus,

$$CR(L) = \sqrt{\sum_{j=1}^{m} p_j\left(\left(\sum_{i=1}^{n} x_{i,j}\right) - CEV(L)\right)^2} = 0$$

since total payoff $\sum_{i=1}^{n} x_{i,j} = 233.72$ for all j.

In the *well-off* scenario the exact same steps were followed with probabilities 0.7 and 0.3 replacing 0.2 and 0.8, respectively.

C.3 Education/Nationality/Income based Distribution

Inequality and risk measures of the Education, Nationality and Income based Distribution are operationalized in the same way as the Random Distribution. However, there is one notable difference, namely that individual outcomes here are determined upfront so that the process that generates them is not stochastic. Even though the decision maker does not know who will get what, education, nationality and income individual characteristics exist before the experiment and before the decision of the social planner. Therefore, payoffs are fixed once the allocation has been chosen and we can say that inequality is

the same ex-ante and ex-post. Note, that risk allocation still follows a stochastic process because every individual, in the *worst-off* scenario, faces 20% probability to end up with 31.14 QALE and 80% to end up with 21.18 QALE.

The ex-post allocation of the Random Distribution, for $n = 10$, can be any combination of individual payoffs, as long as two individuals end up with 21.59 QALE and 8 with 14.22 QALE. The ex-ante allocation is $L = ((20\%(31.14, ..., 31.14); 80\%(21.18, ..., 21.18))$.

Therefore,

$$\overline{x} = \sum_{i=1}^{n} \frac{1}{n} x_i = (\frac{1}{10} * 31.14) * 2 + (\frac{1}{10} * 21.18) * 8 = 23.372$$

and

$$EPI(x) = \sqrt{\sum_{i=1}^{n} \frac{1}{n} (x_i - \overline{x})^2} = \sqrt{\left(\frac{1}{10}(31.14 - 23.372)^2\right) * 2 + \left(\frac{1}{10}(21.18 - 23.372)^2\right) * 8} = 4.384$$

Note, that same as in Random Distribution, we estimate ex-post inequality and not expected ex-post inequality. Furthermore, ex-ante inequality is equal to ex-post inequality, hence

$$EAI = 4.384$$

Individual risk is given by,

$$IR_i(L) = \sqrt{\sum_{j=1}^{m} p_j (x_{i,j} - IEV_i(L))^2} = \sqrt{0.2(31.14 - 23.372)^2 + 0.8(21.18 - 23.372)^2} = 4.384$$

Finally,

$$CEV(L) = \sum_{j=1}^{m} p_j \left(\sum_{i=1}^{n} x_{i,j}\right) = 233.4$$

since outcomes here are standard: $2 * 31.14 + 8 * 21.18$
Thus,

$$CR(L) = \sqrt{\sum_{j=1}^{m} p_j \left(\left(\sum_{i=1}^{n} x_{i,j}\right) - CEV(L)\right)^2} = 0$$

since total payoff $\sum_{i=1}^{n} x_{i,j} = 233.4$ for all j.

In the *well-off* scenario the exact same steps were followed with probabilities 0.7 and 0.3 replacing 0.2 and 0.8, respectively.

C.4 Independent Lottery

In the *worst-off* scenario, every individual receives the lottery $(20\% : 31.14; 80\%\text{''} 21.18)$ independently, Hence, the possible total payoffs vary: they can be 311.4 (if all end up with 31.14 QALE) on one extreme or 211.8 (if they all end up with 21.18 QALE) on the other. In addition, we can identify nine possible scenarios in between, resulting in 11 possible outcomes in total. To estimate the probability of each possible outcome, we make use the probability mass function of the Bernoulli distribution.

The Bernoulli distribution describes situations where the outcome of independent trials is binary: i.e success or failure. The Bernoulli distribution is defined as:

$$f(x) = p^x(1-p)^{1-x}, for x = 0, 1$$

where, p is the probability that a particular even (e.g. success) will occur.

Suppose we repeat the Bernoulli p experiment n times independently and count the number z of successes, we say that the distribution of Z follows the Binomial distribution $B(n, p)$. The probability of k number of success to occur out of n trials is given by:

$$P(z = k) = \binom{n}{k} p^k q^{n-k}$$

where,

$$q = 1 - p, k = 0, 1, ..., n, \binom{n}{k} = \frac{n!}{k!(n-k)!}$$

In this setting and for the *worst-off* scenario we have: $n = 10$, $p = 0, 2$ and $q = 0, 8$.

Consequently, the probability of zero successes ($k = 0$) so that no one ends up with 31.14 QALE (all will end up with 21.18 QALE) is:

$$P(Z = 0) = \binom{10}{0} 0.2^0 0.8^{10} = 0.1073741824$$

while, the probability of one success ($k = 1$) so that only one ends up with 31.14 QALE and nine end up with 21.18 QALE is:

$$P(Z = 1) = \binom{10}{1} 0.2^1 0.8^9 = 0.268435456$$

Working in this way, we can construct the ex-ante allocation $L = (p_1 : X_1, ..., p_m : X_m)$ with $m = 11$, which yields ex-post allocations X_j with probability p_j for every $j = 1, 2, ..., 11$. The ex-ante allocation will look like: $L = (0.1073741824 : (21.18, ..., 21.18), 0.268435456 : (31.14, 21.18, ..., 21.18), ..., p_m : X_m)$.

It follows:

$$IEV_i(L) = \sum_{j=1}^{m} p_j x_{i,j} = 0.1073741824 * 21.18 + 0.268435456 * 22.176 + \ldots = 23.372$$

so that

$$\overline{IEV_i}(L) = \sum_{i=1}^{n} \frac{1}{n} IEV_i(L) = (23.372 * 10)/10 = 23.372$$

and

$$EAI(L) = \sqrt{\sum_{i=1}^{n} \frac{1}{n} \left(IEV_i(L) - \overline{IEV}(L) \right)^2} = 0$$

Expected ex-post inequality is estimated by considering all possible outcomes with their corresponding probabilities. There are 11 possible ex-post allocations, resulting in 11 ex-post average QALE and ex-post inequality values. The expected ex-post inequality is the sum of those ex-post inequalities.

For $Z = 0$, we have:

$$\overline{x}(Z = 0) = \sum_{i=1}^{n} \frac{1}{n} x_i = 21.18$$

so that

$$EPI(Z = 0) = \sqrt{\sum_{i=1}^{n} \frac{1}{n} (x_i - \overline{x})^2} = 0$$

and

$$EEPI(Z = 0) = \sum_{j-1}^{m} \left(p_j EPI(x_j) \right) = 0.1073741824 * 0 = 0$$

For $Z = 1$, we have:

$$\overline{x}(Z = 1) = \sum_{i=1}^{n} \frac{1}{n} x_i = \frac{221.76}{10} = 22.176$$

so that

$$EPI(Z = 1) = \sqrt{\sum_{i=1}^{n} \frac{1}{n} (x_i - \overline{x})^2} = \sqrt{\frac{1}{10}(31.14 - 22.176)^2 + \frac{9}{10}(21.18 - 22.176)^2} = 2.988$$

and

$$EEPI(Z=1) = \sum_{j-1}^{m} \big(p_j EPI(x_j)\big) = 0.268435456 * 2.988 = 0.80208512$$

Working in this way we calculate $EEPI$ for every j, to finally estimate

$$EEPI = \sum_{Z=0}^{11} EEPI(Z) = 3.87$$

Individual risk is estimated by looking at the prospects of the lottery from an individual perspective.

$$IR_i(L) = \sqrt{\sum_{j=1}^{m} p_j \big(x_{i,j} - IEV_i(L)\big)^2} = 4.384$$

Finally,

$$CEV(L) = \sum_{j=1}^{m} p_j \Big(\sum_{i=1}^{n} x_{i,j}\Big) = 0.1073741824 * 211.8 + 0.268435456 * 221.76 + ... = 233.72$$

And

$$CR(L) = \sqrt{\sum_{j=1}^{m} p_j \Big(\big(\sum_{i=1}^{n} x_{i,j}\big) - CEV(L)\Big)^2} = \sqrt{0.1073741824(211.8 - 233.72)^2 + ...} = 13.86$$

In the *well-off* scenario the exact same steps were followed with probabilities 0.7 and 0.3 replacing 0.2 and 0.8, respectively.

D Majority preferences of risk allocation procedures

Table 14: Allocation Type counts of binary responses.

Allocation Procedures	Experimental Conditions	
	well-off	*worst-off*
Common Outcome	248 (24%)	188 (22%)
Independent Lottery	187 (18%)	144 (17%)
Random Distribution	163 (16%)	123 (15%)
Income Based Distribution	158 (15.5%)	148 (18%)
Common Lottery	149 (14.5%)	121 (14%)
Nationality Based Distribution	55 (5%)	58 (7%)
Education Based Distribution	69 (7%)	58 (7%)
Total	1029	840

Note: Numbers indicate how many times each allocation procedure was chosen. In total, 49 and 40 respondents in the *well-off* and *worst-off* scenario, respectively, answered 21 questions each. Hence, 1029 and 840 total choices in the two scenarios. Shares are reported in parentheses.