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Ferdinand Vieider
Clara Villegas-Palacio
Peter Martinsson
Milagros Mejía

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Wissenschaftszentrum Berlin für Sozialforschung gGmbH
Reichpietschufer 50
10785 Berlin
Germany
www.wzb.eu

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Affiliation of the authors:

Ferdinand Vieider
WZB

Clara Villegas-Palacio
National University of Colombia, Medellín Campus, Colombia

Peter Martinsson
University of Gothenburg, Sweden

Milagros Mejía
USMP-Instituto del Peru, Peru

Wissenschaftszentrum Berlin für Sozialforschung gGmbH
Reichpietschufer 50
10785 Berlin
Germany
www.wzb.eu

Abstract

Risk taking for oneself and others: A structural model approach

by Ferdinand Vieider,* Clara Villegas-Palacio, Peter Martinsson and Milagros Mejía

We examine situations in which a decision maker decides for another person as well as herself under conditions of payoff equality, and compare such decisions under responsibility to individual decisions. Estimating a structural model we find that responsibility leaves utility curvature unaffected, but accentuates the subjective distortion of very small and very large probabilities for both gains and losses. This results in an accentuation of prospect theory's four-fold pattern of risk preferences under responsibility. In addition, we also find that responsibility reduces loss aversion according to some common definitions of the latter. These results serve to reconcile some of the still largely contradictory findings in the literature on decisions for oneself and others under payoff equality.

Keywords: risk preferences; responsibility; social preferences;

JEL-classification: C93; D03; D80; O12

* E-mail: ferdinand.vieider@wzb.eu.
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1 Introduction

The focus of decision theory has long been on individual decision processes, whereby the decision maker is the only person affected by her decisions. In many situations, however, financial decisions have payoff consequences affecting not only the decision maker herself but also others—be they family members, or principals for whom an agent is called to make a decision. We focus on situations where incentives are perfectly aligned between agent and principal (e.g., a CEO compensated in restricted company stock; a family head who administers the finances for the household). The question, then, is whether decisions taken when responsible for somebody else's payoffs as well as one's own differ from decisions taken in the purely individual context. The answer to this question has implications for whether what we know from the wide-ranging literature on individual decisions can be directly applied to such situations of *responsibility*, or not.

We are interested in situations of *payoff equality*, in which a decision maker and a passive other (whom we shall refer to as *recipient*) are affected by the payoffs resulting from a decision in a symmetric fashion. Bolton and Ockenfels (2010) found no difference between a situation of individual decisions and one in which the decision maker and the recipient were equally affected by the decisions. Pahlke, Strasser and Vieider (2010) studied decisions under payoff equality for the gain and loss domain, as well as for different probabilities and for mixed gain-loss prospects. They concluded that responsibility increased risk aversion for moderate to large probability prospects in the gain domain, but increased risk seeking for moderate probability losses and small probability gains, pointing to an accentuation of the four-fold pattern of risk attitudes found under prospect theory (Tversky and Kahneman, 1992). They found no effect of responsibility on mixed gain-loss prospects. Humphrey and Renner (2011) found no effect of responsibility using a price-list design popularized by Holt and Laury (2002). Andersson, Holm, Tyran and Wengström (2015) estimated a structural model of decision making and found no effect of responsibility on utility curvature, but found loss aversion to be reduced relative to individual decisions in situations of payoff equality. Bolton, Ockenfels and Stauf (2015) found risk aversion to increase in situations of payoff equality under responsibility.

Choice situations involving payoff equality must be distinguished from a number of other decision situations, which, while being related, differ from it in one or more important aspects. Most closely related are studies in which an agent decides for a principal without any consequences to herself, and which compare such an agency choice to individual decisions the agent takes for herself. Investigating such a situation, Chakravarty, Harrison, Haruvy and Rutström (2011) found increased risk taking in decisions for others. Reynolds, Joseph and Sherwood (2009), on the other hand, found agents to be more risk averse when deciding for a group of three to five others than when deciding for themselves. Eriksen and Kvaløy (2010) investigated myopic loss aversion using an investment task (Gneezy and Potters, 1997), and found risk taking to decrease in decisions for others. Using the same task, Pollmann, Potters and Trautmann (2014) found risk taking to *increase* when making decisions for others. In agreement with the last results, Polman (2012) found loss aversion to decrease in decisions for other in a simple choice task.[1] Other more remotely related studies concern situations in which payoffs accrue to others in strategic game settings (see e.g. Charness and Jackson, 2009), or in group decisions (see e.g. Sutter, 2009)—see Trautmann and Vieider (2012) for an overview. We will henceforth concentrate on situations of payoff equality, but will return to these related studies in the discussion.

In this paper we revisit the issue of responsibility under payoff equality using a rich data set specifically designed to estimate structural models. Compared to Pahlke et al. (2010), we explore an even richer domain of decision situations, including gains and losses across a variety of probability levels and outcomes, as well as mixed gain-loss prospects. This allows us to estimate a full structural

[1] Yet a different class of decision situations involve so-called *accountability*. Pahlke, Strasser and Vieider (2012) investigated situations of payoff equality, where the treatment conisted in requiring the decision makers to justify her decisions in front of the recipient. They found that such accountability reduces loss aversion. Pollmann et al. (2014) implemented a different accountability mechanism in situations where agents took decisions on behalf of principals, where the principal could reward the agent for the decision taken either before the outcome becomes known or after. They find this accountability mechanism to reduce risk taking for both accountability mechanisms relative to decisions for others without accountability.

model of prospect theory, which makes it possible to identify systematic trends in the data and to test different hypotheses on the effect of responsibility against each other. Compared to the structural model estimated by Andersson et al. (2015), who use only 50-50 prospects over gains or mixed prospects over gains and losses, the richness of our decision tasks allows us to estimate a completely flexible structural model, including different utility functions for gains and losses, domain-specific probability weighting functions, and loss aversion. This allows us to approximate some of the different decision situations and modeling assumptions used in the literature on responsibility under payoff equality, and thus to try and consolidate a quickly growing but still largely contradictory literature.

The results paint a clear picture. For both gains and losses, probability weighting becomes more extreme under responsibility relative to individual decisions. This results in an accentuation of the four-fold pattern of risk attitudes under responsibility relative to the individual baseline—increased risk seeking for small probability gains and moderate to large probability losses, increased risk aversion for moderate to large probability gains and small probability losses. These results may reconcile the different conclusions reached by Bolton and Ockenfels (2010), Pahlke et al. (2010), Humphrey and Renner (2011), Andersson et al. (2015), and Bolton et al. (2015) concerning the effects of responsibility for moderate probability gains. This derives directly from our insight that the effect of responsibility changes systematically across probability levels, so that differences will be most pronounced for very large and very small probabilities, while they are likely to be weaker for the 50-50 probabilities employed in most studies. We also confirm the finding by Andersson et al. (2015) of reduced loss aversion under responsibility. This finding, however, holds only for a specific definition of loss aversion mimicking their structural model, while the effect fails to reach significance under a different definition, thus partially reconciling their finding with the null-finding by Pahlke et al. (2010).

2 Modeling and experiment

2.1 Theory and hypotheses

We adopt prospect theory (PT) as our main model of choice (Kahneman and Tversky, 1979). PT is descriptively superior to expected utility theory (Barberis, 2013; Barseghyan, Molinari, O'Donoghue and Teitelbaum, 2013; Starmer, 2000). It includes reference-dependent formulations of expected utility theory (EUT) as a special case. First proposed by Markowitz (1952), such modifications of EUT have enjoyed increased popularity of late in both the empirical and theoretical literature (Andersson et al., 2015; Diecidue and van de Ven, 2008; Kőszegi and Rabin, 2007; Sugden, 2003; von Gaudecker, van Soest and Wengström, 2011). PT's main difference from reference-dependent formulations of EUT is that it allows for subjective transformations of probabilities into decision weights in addition to subjective transformation of outcomes into utilities. This will allow us to test hypotheses of a cautious shift under responsibility (Bolton and Ockenfels, 2010; Bolton et al., 2015) directly against a hypothesis of an accentuation of the four-fold pattern of risk preferences (Pahlke et al., 2010), as well as any potential effects on loss aversion (Andersson et al., 2015).

The four-fold pattern of risk preferences consists in the finding that people are generally risk averse for moderate to large probability gains and small probability losses, while being risk seeking for small probability gains and moderate to large probability losses (Tversky and Kahneman, 1992). This pattern derives directly from the concept of *probabilistic insensitivity*, whereby people tend to systematically distort probabilities, overweighting small probabilities and underweighting moderate to large probabilities (Abdellaoui, 2000; Bleichrodt and Pinto, 2000; Kilka and Weber, 2001; Wu and Gonzalez, 1996).[2]

Probabilistic insensitivity is best characterized in terms of upper or lower subadditivity (Tversky and Wakker, 1995), whereby the same difference in terms

[2]We follow the convention in the literature to apply probability transformations to the highest outcome in absolute terms, so that effects for losses are mirrored with respect to those for gains. This means that, assuming linear utility, the overweighting of small probabilities indicates risk seeking for gains, but risk aversion for losses. Similarly, the typically found underweighting of large probabilities indicates risk aversion for gains, but risk seeking for losses.

of probabilities results in a smaller difference in probability weights away from the endpoints of $p = 0$ and $p = 1$ than close to them, thus giving rise to the characteristic inverse-S shape of the weighting function. Lower subadditivity is often referred to as the *possibility effect* and can be formalized for a constant $\epsilon \geq 0$ as $\pi(q) - \pi(0) \geq \pi(q+p) - \pi(p)$ whenever $q + p \leq 1 - \epsilon$, where π indicates a subjective decision weight. Upper subadditivity is commonly known as the *certainty effect*, and can be formalized for a constant $\epsilon' \geq 0$ as $\pi(1) - \pi(1-q) \geq \pi(p+q) - \pi(p)$ whenever $p \geq \epsilon'$. Figure 1 illustrates this idea for a typical probability weighting function using the special case of $p = q$. Moving from a probability of 0 to a probability q results in a probability weight of $\pi(q)$. However, once we increase the probability from q to $2q$, this adds only an additional $\pi(2q) - \pi(q)$ to the overall decision weight, which is clearly smaller than $\pi(q)$. A parallel but mirrored observation holds for the opposite side of the probability spectrum, where $1 - \pi(1-q)$ is much larger than the decision weight contributed by an equivalent increase in probability mass aways from certainty, $\pi(1-q) - \pi(1-2q)$.

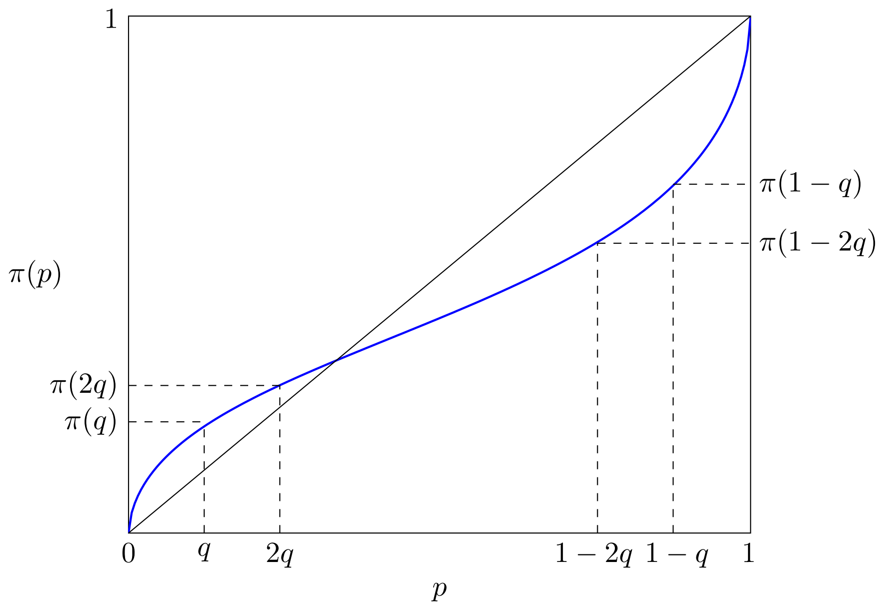


Figure 1: The certainty and possibility effects and probabilistic insensivity

Economic theory is silent on the type of decisions described in this paper.[3] Building on the findings of Pahlke et al. (2010), we hypothesize responsibility may lead to higthened affect relative to individual decisions. Rottenstreich and Hsee (2001) showed that increased affect associated with an outcome reduces probabilistic sensitivity, even keeping subjective valuations of the outcomes constant. Hsee and Rottenstreich (2004) further showed that such increased affect will result in larger jumps at the probability endpoints, and thus a flatter probability weighting function in intermediate probability ranges. This line of reasoning leads us to hypothesize that being responsible for somebody else's outcomes as well as one's own will result in decreased probabilistic sensitivity.

We are now in a position to formalize our simple model. We describe decisions over binary prospects offering a probability p of winning (losing) an outcome x, or else y with a complementary probability, represented $(x, p; y)$. For outcomes that fall purely into one domain, i.e. $x > y \geq 0$ or $0 \geq y > x$, we can represent the utility of a prospect ξ, $U(\xi)$, as follows:

$$U(\xi_i) = w_r^j(p_i)v(x_i) + [1 - w_r^j(p_i)]v(y_i) \tag{1}$$

whereby the probability weighting function $w(p)$ is a strictly increasing function that maps probabilities into decision weights, and which satisfies $w(0) = 0$ and $w(1) = 1$; the superscript j indicates the decision domain and can take the values $+$ for gains and $-$ for losses; the subscript i indicates the particular prospect at hand; and $v(.)$ represents a utility or value function which indicates preferences over outcomes, with a fixed point such that $v(0) = 0$. The subscript r to the probability weighting function indicates that probability weighting (and only probability weighting) is considered a function of the treatment, and may thus differ between individual decisions and decisions under responsibility. For mixed prospects, where $x > 0 > y$, the utility of the prospect can be represented as:

[3]Notice that theories modeling social effects on decisions, such as the model of Fehr and Schmidt (1999), concern only situations of payoff inequality, and make no predictions for the case in which the payoffs of the decision maker and the recipient are axactly equal.

$$U(\xi_i) = w_r^+(p_i)v(x_i) + \lambda_r w_r^-(1-p_i)v(y_i) \tag{2}$$

where λ indicates loss aversion, generally represented as a kink in the utility function at the origin (Abdellaoui, Bleichrodt and Paraschiv, 2007; Köbberling and Wakker, 2005). With this theoretical setup in mind, we can now further clarify our hypotheses:

> ***H1***: Being responsible for somebody else's outcomes in addition to one's own results in decreased probabilistic sensitivity
>
> ***H2***: Utility curvature for gains and losses is unaffected by responsibility, given that the treatment does not affect the value attributed to money
>
> ***H3***: Loss aversion is reduced by responsibility

We have explained our reasoning behind H1 above and will return to it in the discussion. H2 follows from the observation that a subject's own utility over money ought to be unaffected by the treatment (this is similar to the finding that utility is not affected by preferences over sources of uncertainty; see Abdellaoui, Baillon, Placido and Wakker, 2011, and Abdellaoui, Bleichrodt, L'Haridon and Van Dolder, 2013).[4] The reasoning for loss aversion is different. Indeed, it may appear odd that one treats loss aversion differently than utility curvature, since under prospect theory loss aversion is part of the utility function. Nevertheless, loss aversion is well known to be the most volatile component of utility (List, 2004; Wakker, 2010). There exists furthermore evidence that loss aversion may be reduced under conditions of responsibility (Andersson et al., 2015), or when decision makers think they may need to justify their choices to somebody else (Pahlke et al., 2012; Vieider, 2009).

[4]An alternative prediction derives from the observation that being responsible for somebody else entails deciding over twice the monetary stakes. In this case, we would expect utility to be more concave under responsibility than in the individual treatment (or the weighting function to shift uniformly downwards for gains), since risk aversion has been found to increase in stake elevels for both large and small probabilities for gains (Fehr-Duda, Bruhin, Epper and Schubert, 2010; Holt and Laury, 2002; Kachelmeier and Shehata, 1992; Lefebvre, Vieider and Villeval, 2010). This alternative hypothesis will also be tested below.

2.2 The experiment

We recruited 200 subjects at the National University of Colombia, Medellín Campus, and randomly assigned half to the individual and half to the responsibility treatment.[5] 55% of subjects were male, and the average age was 21.2 years. Most of the subjects studied mathematics (72%) or economics (10%). The experiment was run using paper and pencil. The whole experiment, including payout, lasted about 1h to 1h15.

We elicit certainty equivalents (*CEs*) to measure risk preferences. CEs provide a rich amount of information, are easy to explain to subjects, and the sure amounts of money to be used in the elicitation are naturally limited between the lower and upper amount of the prospect. This makes them well suited to estimate structural models (Abdellaoui et al., 2011; Bruhin, Fehr-Duda and Epper, 2010). By varying the outcomes and the probabilities involved, it is easy to create the type of orthogonality needed to separate attitudes towards outcomes from attitudes towards probabilities, reflected in the utility function and the probability weighting function respectively.

Table 1: Decision tasks, amounts in PPP Euros

gains	losses	mixed
(5, 1/2; 0)	(-5, 1/2; 0)	0∼(20, 1/2; z*)
(10, 1/2; 0)	(-10, 1/2; 0)	
(20, 1/2; 0)	(-20, 1/2; 0)	
(30, 1/2; 0)	(-20, 1/2; -5)	
(30, 1/2; 0)	(-20, 1/2; -10)	
(30, 1/2; 10)		
(20, 1/8; 0)	(-20 1/8; 0)	
(20, 2/8; 0)	(-20, 2/8; 0	
(20, 3/8; 0)	(-20, 3/8; 0)	
(20, 5/8; 0)	(-20, 5/8; 0)	
(20, 6/8; 0)	(-20, 6/8; 0)	
(20, 7/8; 0)	(-20, 7/8; 0)	

For mixed prospects, the loss z was varied in the elicitation

Overall, we elicited 36 CEs per subject, but we here concentrate on the 24 choice lists involving known probabilities. Table 1 provides an overview of the

[5] The 100 subjects in the individual treatment are also part of the Colombian sample in the large data set presented by Vieider, Lefebvre, Bouchouicha, Chmura, Hakimov, Krawczyk and Martinsson (2014).

decision tasks, and figure 2 shows an example of a choice list. Prospects are described in the format $(x, p; y)$, where p is the probability of obtaining x, and y obtains with a complementary probability $1 - p$, $|x| > |y|$. Outcomes are shown in PPP Euros (Euro 1 = US \$1.2 = 1,500 Columbian Pesos in PPP). The sure amounts in a choice list were always made to vary between the lowest and the highest amount, avoiding potential distortions due to noise in unbalanced choice lists (Andersson, Tyran, Wengström and Holm, 2013). We imposed single switching in the choice lists, so as to impute a unique switching point to each subject. This was done to avoid potential issues with different proportions of multiple switchers across treatments, since no clear preferences can be assigned to such individuals assuming monotonicity. The average between the last sure amount for which the safe option was chosen and the first for which the prospect was chosen is then encoded as the CE of the prospect. In addition to the prospects over gains and losses, we used one mixed prospect, which is necessary to obtain a measure of loss aversion. In this case, we obtained the value z^* which satisfies the indifference $0 \sim (20, 1/2; -z)$, where z varied in a choice list from -20 to -2.[6]

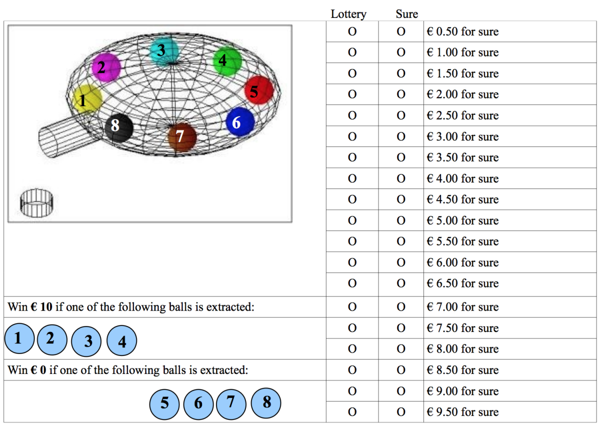


Figure 2: Example of choice list to elicit a CE

Gains were administered before losses, which took part from an endowment (see Etchart-Vincent and L'Haridon, 2011, for evidence that it does not matter

[6]The instructions for the individual treatment are available for download at www.ferdinandvieider.com/instructions.html.

whether losses take place from an endowment or are real). We also had ambiguous prospects that will not be analyzed here, and which were always presented in block after the risky prospects. The prospects were presented to subjects in a fixed order, whereby first 50-50 prospects were presented in order of ascending expected value, and then the remaining prospects were presented in order of increasing probability. The fixed order was kept since a large-scale pilot involving 330 subjects showed that it made the task less cognitively demanding than a random ordering, while having no effect on the preference parameters (results available upon request). The ordering is the same across the treatment and control groups.

The treatment was implemented using the strategy method. In the individual condition, each subject was told that (s)he would play out one of the decisions selected at random—the standard procedure in this kind of experiment (Baltussen, Post, van den Assem and Wakker, 2012; Cubitt, Starmer and Sugden, 1998). Each task had the same probability of being extracted for real play, after which one of the decisions in the chosen task would be chosen at random, again with equal probability. In the responsibility condition, subjects learned that, after they had completed the experiment, half of them would be randomly extracted to play the role of decision maker, and half the role of recipient. This allowed us to have a relatively large subject pool, and avoided additional complications arising from the need to invite completely passive recipients. Each decision maker would then be randomly and anonymously paired with one recipient. At this point, one of the choices of the decision maker would be randomly extracted to be played for real money according to procedures identical to those used in the individual condition. The payoff obtained from playing this task would then be given both to the decision maker and to the recipient, whose own decisions would not be played out.

2.3 Functional forms and econometric approach

In order to specify the model, let us now determine the functional forms to be used. For the utility function, we use a sign-dependent power function. This is the most popular function in the empirical literature and it has some desirable theoretical qualities (Wakker, 2008). It has also been found to provide the best compromise between fit and parsimony in prospect-theory models (Stott, 2006). We thus adopt the following functional form:

$$v(x) = \begin{cases} x^{\mu} & \text{if } x > 0 \\ -(-x)^{\nu} & \text{if } x \leq 0 \end{cases} \tag{3}$$

where μ and ν are the utility curvature parameters for gains and losses respectively. Using different functional forms or the same utility parameter for gains and losses does not qualitatively affect our findings.

For weighting, we adopt the 2-parameter weighting function developed and axiomatized by Prelec (1998). Using a two-parameter function gives us maximum flexibility in the estimations. The results are qualitatively stable if we use an alternative two-parameter function such as the one developed by Goldstein and Einhorn (1987) and Lattimore, Baker and Witte (1992). The function takes the following form:

$$w(p) = exp(-\beta^{j}(-ln(p))^{\alpha_r^j}) \tag{4}$$

where β is a parameter that governs mostly the elevation of the weighting function, with higher values indicating a less elevated function. Since this indicates the weight assigned to the best outcome for gains, and the weight assigned to the worst outcome for losses, a higher value of β *ceteris paribus* indicates increased risk aversion for gains, and increased probabilistic optimism for losses over the probability space on average. The parameter α governs the slope of the probability weighting function and hence probabilistic sensitivity. The subscript r serves to emphasize hypothesis 1, according to which probabilistic sensitivity will be lower under responsibility than in the individual treatment. A value of $\alpha = 1$ indicates linearity of the weighting function (the EUT case), and $\alpha < 1$ representing the typical case of *probabilistic insentivity.* The parameter β is explicitly not made to depend on the treatment r. Nonetheless, we will make all parameters dependent on the treatment dummy in our analysis below, to test our hypothesis against alternative theories of a cautious shift under responsibility (Bolton and Ockenfels, 2010; Bolton et al., 2015), which would manifest itself either in increased utility curvature or in a higher value of β^+ for gains (the papers cited make no explicit prediction for losses, but increased caution would manifest itself in a *lower* value of β^- in the loss domain).

The model considered so far is fully deterministic, assuming that subjects know their preferences perfectly well and execute them without making mistakes. We now abandon this restrictive assumption and introduce an explicit stochastic structure. We start from the observation that our experimental tasks consist in eliciting certainty equivalents for different prospects, such that by definition $ce_i \sim (x_i, p_i; y_i)$, where $\sim$ indicates indifference. We can represent this indifference by expressing the ce as a function of the utility representation in equation 1 above:

$$\hat{ce}_i = v^{-1}[w_r^j(p_i)v(x_i) + \left(1 - w_r^j(p_i)\right) v(y_i)] \tag{5}$$

Given this setup, the actual certainty equivalent we observe will be equal to the certainty equivalent calculated from our model plus some error term, or $ce_i = \hat{ce}_i + \epsilon_i$.[7] We assume this error to be normally distributed, $\epsilon_i \sim N(0, \sigma_i^2)$. This assumptions allows for serially correlated errors by the same decision maker, which is not possible under a logit model (see again Train, 2009). Following Bruhin et al. (2010), we can now express the probability density function $\psi(.)$ for a given subject n and prospect i as follows

$$\psi(\theta_{nr}, \sigma_{nijr}) = \frac{1}{\sigma_{nijr}} \, \phi\left(\frac{\hat{ce}_{nir} - ce_{ni}}{\sigma_{nijr}}\right) \tag{6}$$

where ϕ is the standard normal density function, and $\theta = \{\mu, \nu, \lambda, \alpha^j, \beta^j, \}$ indicates the vector of decision-maker specific parameters to be estimated. The subscripts n and r to the parameter vector θ indicate that we estimate the pa-

[7]The procedure followed for mixed prospects as represented in equation 2 is similar, except that we derive everything in terms of the elicited loss amount z instead of a certainty equivalent. The explicit derivation is omitted from the text for parsimony.

rameters as a linear function of the treatment as well as observable subject characteristics, i.e. $\hat{\theta} = \theta_k + \beta R + \gamma X$, where θ_k is a vector of constants, R is a dummy that is 1 for the responsibility treatment and else 0, and X is a matrix of observable characteristics of the decision makers. Notice how *all* the parameters in the vector θ will now be regressed on the treatment, since our hypotheses laid out above need to be tested empirically and cannot simply be imposed on the structural model. Finally, σ indicates a so-called Fechner error (Hey and Orme, 1994). The subscripts emphasize that we are allowing for four different types of heterscedasticity, whereby n indicates as usual the observable characteristics of the decision maker, j indicates the decision domain (gains vs. losses; the error for the mixed domain is assumed equal to the one for losses, as we elicited the loss amount for that case). The subscript i indicates that we allow the error term to depend on the specific prospect, or rather, on the difference between the high and low outcome in the prospect, such that $\sigma_i = \sigma|x_i - y_i|$.[8] This allows the error term to differ for choice lists of different lengths, since the sure amount always varies in equal steps between x_i and y_i. Finally, the subscript r indicates that we also allow for heteroscedasticity across treatments.

These parameters can now be estimated by standard maximum likelihood procedures. To obtain the overall likelihood function, we now need to take the product of the density functions above across prospects for each subject:

$$L_n(\theta_{nr}) = \prod_i \psi(\theta_{nr}, \sigma_{nijr}) \tag{7}$$

where θ is the vector of parameters to be estimated such as to maximize the likelihood function. Taking logs and summing over decision makers we obtain

$$LL(\theta_{nr}) = \sum_{n=1}^{N} \ln\left[\psi(\theta_{nr}, \sigma_{nir})\right] \tag{8}$$

[8] Wilcox (2011) pointed out a potential probelm when applying such a model in a discrete choice setup, whereby the probability of choosing the riskier prospect may be increasing in risk aversion in some cases. This probelm does not apply in our setting. Also, Apesteguia and Ballester (2014) have shown that this probelm does not occur even in discrete choice models when a derived certainty equivalent is compared to a sure amount, as in our setup.

We estimate this log-likelihood function in Stata 13 using the Broyden-Fletcher-Goldfarb-Shanno optimization algorithm. Errors are always clustered at the subject level.

3 Results

We present the results in three parts. The first part establishes the main results and shows our structural estimations. In part 2, we look at alternative definitions of loss aversion and the extent to which these definitions reconcile differential findings in the literature. Finally, part three systematically revisits the literature on decisions under responsibility for gains, and explores the extent to which these studies can be reconciled by the evidence supplied here.

3.1 Results of structural estimations

The results from the structural estimation of the prospect theory model laid out above are shown in table 2. The regression makes all variables of the model, as well as the noise term, depend on the treatment dummy. In addition, the regression controls for sex and age of the subjects. We find that older subjects have more concave utility for gains, but that they are also less loss averse (however, see below). Older subjects also exhibit more noise in their decision processes.

This brings us to the treatment effects. Being responsible for somebody else's payoffs as well as one's own significantly decreases probabilistic sensitivity relatively to the individual baseline for both gains and losses. This confirms our hypothesis 1. There are no effects on the elevation of the probability weighting function for either gains or losses. There are also no effects on utility curvature. This confirms our hypothesis 2, and indicates that there is no general cautious shift, nor can the results be explained by potential stake effects in the responsibility treatment. Finally, we find no differences between treatments in terms of loss aversion. Hypothesis 3 is thus not supported by the data.

Table 3 replicates the regressions from table 2, dropping the treatment dummy for the utility curvature parameters. This is instructive inasmuch as the utility

Table 2: Structural estimation of PT model

$LL = -15,448$	utility			$w(p)$ gains		$w(p)$ losses		
$N = 200$	μ	ν	λ	α^+	β^+	α^-	β^-	σ
responsibility	-0.161	-0.148	-0.192	-0.139**	-0.139	-0.124*	-0.119	0.020
	(0.116)	(0.184)	(0.240)	(0.064)	(0.118)	(0.071)	(0.178)	(0.013)
male	0.194	0.211	0.126	0.025	0.131	-0.022	0.235	0.010
	(0.126)	(0.195)	(0.239)	(0.066)	(0.123)	(0.072)	(0.181)	(0.013)
age	-0.122**	-0.077	-0.095***	0.011	-0.050	-0.012	-0.049	0.013**
	(0.052)	(0.074)	(0.032)	(0.032)	(0.050)	(0.038)	(0.067)	(0.006)
constant	0.979***	1.525***	0.776***	0.673***	0.982***	0.841***	1.336***	0.202***
	(0.110)	(0.190)	(0.269)	(0.061)	(0.101)	(0.057)	(0.170)	(0.012)

Standard errors in parentheses, * p<0.10, ** p<0.05, *** p<0.01; z-score used for age

curvature parameters and the elevation parameter for the probability weighting function are collinear, moving in opposite directions in the regression in table 2.[9] This affords a cleaner test of our hypothesis of increased sensitivity. We keep the treatment dummy for all parameters of the weighting function, including the elevation parameters, to test for potential global effects which are unchanging across the probability spectrum. We also keep the dummy for loss aversion.

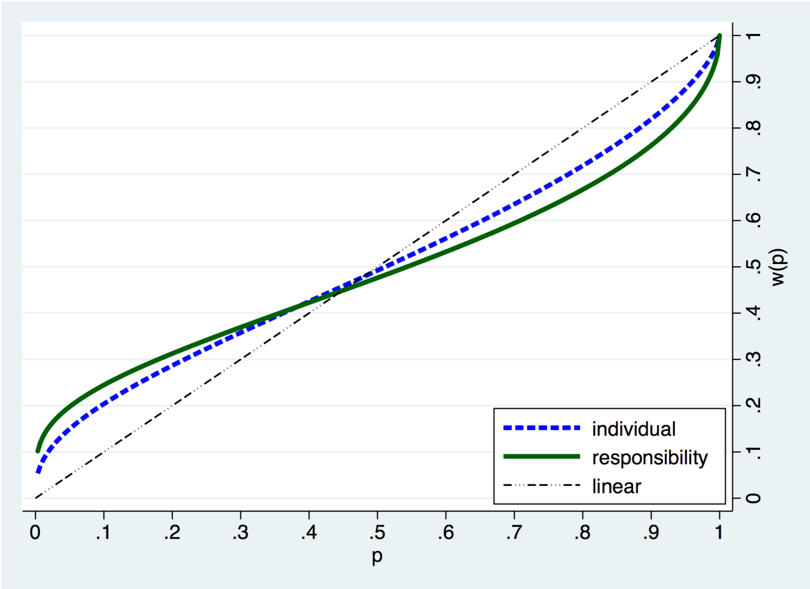
Table 3: Structural estimation of PT model, hypothesized effects

$LL = -15,483$	utility			$w(p)$ gains		$w(p)$ losses		
$N = 200$	μ	ν	λ	α^+	β^+	α^-	β^-	σ
responsibility			-0.111	-0.137**	0.005	-0.119*	-0.002	0.019
			(0.089)	(0.064)	(0.057)	(0.071)	(0.077)	(0.013)
male	0.211	0.182	0.190	0.025	0.144	-0.026	0.210	0.009
	(0.151)	(0.205)	(0.263)	(0.066)	(0.139)	(0.072)	(0.187)	(0.014)
age	-0.115	-0.064	-0.100***	0.007	-0.047	-0.012	-0.041	0.013**
	(0.086)	(0.104)	(0.032)	(0.031)	(0.078)	(0.039)	(0.085)	(0.007)
constant	0.891***	1.468***	0.700***	0.671***	0.906***	0.840***	1.291***	0.203***
	(0.087)	(0.147)	(0.194)	(0.060)	(0.089)	(0.058)	(0.137)	(0.013)

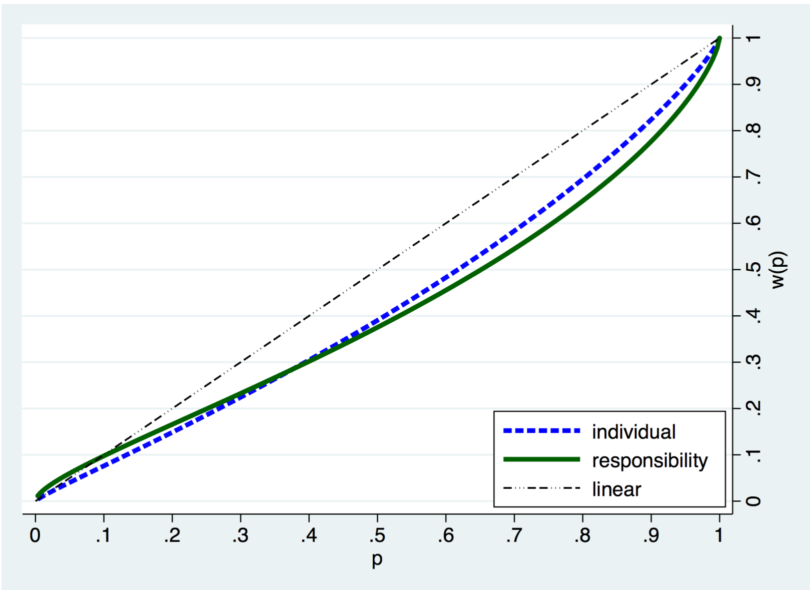
Standard errors in parentheses, * p<0.10, ** p<0.05, *** p<0.01; z-score used for age

The results confirm the ones uncovered in the first regression. We find reduced probabilistic sensitivity for both gains and losses. The elevation parameters are not significantly affected by the treatment. Relative to table 2, the point estimates of the treatment differences for the elevation parameters are now also tiny, which derives from the elimination of the collinearity with the utility parameters.

[9] To see this, notice how μ and β^+ both have a negative coefficient. For utility, this indicates increased curvature, and hence more risk aversion. For the weighting function, this indicates a higher elevation, and thus *less* risk aversion. An equivalent but mirrored conclusion holds for losses. Such collinearity between utility and weighting is indeed unavoidable in structural estimations of prospect theory—see Zeisberger, Vrecko and Langer (2012) for a discussion.



(a) gains



(b) losses

Figure 3: Probability weighting functions, treatment effect

In order to better illustrate the findings, figure 3 shows a graph of the weighting functions for both gains (panel 3(a)) and losses (panel 3(b)). For gains, the function under responsibility is more elevated than the one from the individual treatment for small probabilities, indicating increased risk seeking under responsibility for small probabilities. The two functions cross just below $p = 0.4$, after which the weighting function in the responsibility treatment stays below the one in the individual treatment, indicating increased risk aversion under responsibility. For losses, both functions are more depressed, indicating risk seeking. Nonetheless, the relation between the two functions is similar to the one for gains (if somewhat weaker). This indicates more risk aversion under responsibility for small probabilities, and increased risk seeking for moderate to large probabilities.

The effects found correspond closely to those predicted by Pahlke et al. (2010). This is all the more remarkable since a) the elicitation tasks were quite different; and b) the hypotheses were blind to the experimenter executing the experiments. In contradiction to our hypothesis 3, and other than reported by Andersson et al. (2015), we do not find an effect of the treatment on loss aversion, even though our manipulation is the same as in their equal payoffs treatment. One reason for this may lie in the different model we estimate—this is further explored in the next section.

3.2 Definitions of loss aversion

Given our modeling assumptions, the loss aversion parameter will be influenced by both utility and probability weighting for gains and losses, i.e. $\lambda = \frac{w^{+}(p)v(x)}{w^{-}(p)v(y)}$, as is typical for cumulative prospect theory (Schmidt and Zank, 2005). This also results in the extremely low value of loss aversion as reflected in the constant, which is largely due to the highly concave utility function for losses.[10] Andersson et al. (2015), on the other hand, do not estimate probability weighting. Also, since they have no choices in the pure loss domain, they must assume utility curvature for losses to be the same as for gains—an assumption that is rejected by our data. We now proceed to testing whether the treatment effect on loss aversion is different assuming other definitions of loss aversion.

As a first step, we reestimate our model using a 'behavioral' definition of loss aversion, whereby $\lambda = \frac{x}{-y}$. This is a definition that is commonly used in the literature (e.g., Gächter, Johnson and Herrmann, 2010; Tanaka, Camerer

[10] This may be considered to be somewhat unusual. However, utility functions for losses have been found to take different shapes, from convex to linear and concave (Abdellaoui, Bleichrodt and L'Haridon, 2008).

and Nguyen, 2010), and which may give a cleaner indication of loss aversion, assuming that in the mixed domain the 50-50 probabilities are edited out and utility curvature likely plays a minor role. The results are reported in table 4 (results omitting the treatment dummy are virtually identical, and are not shown due to space constraints). Looking at the constant, we can see that the baseline loss aversion estimated is now much closer to the canonical value of 2.25 reported by Tversky and Kahneman (1992). In addition, loss aversion is now found to decrease in the responsibility treatment relative to the individual treatment. This finding is thus in full agreement with the one by Andersson et al. (2015), even though the effect is only marginally significant in our data.

Table 4: Structural model with 'behavioral' loss aversion

$LL = -15,449$	utility			$w(p)$ gains		$w(p)$ losses		
$N = 200$	μ	ν	λ	α^+	β^+	α^-	β^-	σ
responsibility	-0.153	-0.174	-0.184*	-0.138**	-0.132	-0.125*	-0.138	0.020
	(0.123)	(0.211)	(0.108)	(0.064)	(0.123)	(0.071)	(0.194)	(0.013)
male	0.206	0.142	0.004	0.025	0.142	-0.025	0.182	0.010
	(0.136)	(0.212)	(0.110)	(0.066)	(0.130)	(0.073)	(0.189)	(0.013)
age	-0.122**	-0.065	0.023	0.011	-0.051	-0.011	-0.040	0.013**
	(0.053)	(0.116)	(0.068)	(0.032)	(0.050)	(0.039)	(0.093)	(0.006)
constant	0.969***	1.571***	2.097***	0.672***	0.974***	0.843***	1.370***	0.202***
	(0.112)	(0.205)	(0.094)	(0.061)	(0.102)	(0.057)	(0.179)	(0.012)

Standard errors in parentheses, * p<0.10, ** p<0.05, *** p<0.01; z-score used for age

We can even go one step further and try and exactly replicate the model estimated by Andersson et al. (2015). Since they use only 50-50 prospects over gains or mixed gain-loss prospects, we start by excluding all our prospects having a different probability, as well as our pure loss prospects. Next we restrict the utility parameter to be the same for gains and losses, $\mu \equiv \nu$, and impose that probabilities be treated linearly, i.e. $w(p) \equiv p$. The model estimated on these parameters only is shown in table 5, with regression I being homoscedastic across decision makers and regression II introducing heteroscedasticity (as in all our models above). In both regressions, we reproduce their main results of a) no effect of the treatment on utility curvature; and b) decreased loss aversion under responsibility for others.

This shows that the difference between the results obtained in this study

Table 5: Structural estimation, Andersson et al. model

	I			II		
	μ	λ	σ	μ	λ	σ
responsibility	-0.040	-0.256**		-0.035	-0.229**	0.009
	(0.049)	(0.112)		(0.050)	(0.114)	(0.013)
male	0.039	0.085		0.023	0.047	0.006
	(0.050)	(0.118)		(0.052)	(0.125)	(0.013)
age	-0.065***	-0.119*		-0.054**	-0.081	0.016**
	(0.022)	(0.061)		(0.024)	(0.086)	(0.007)
constant	0.935***	2.019***	0.212***	0.939***	2.011***	0.203***
	(0.040)	(0.099)	(0.006)	(0.040)	(0.099)	(0.012)
Subjects	200	200	200	200	200	200
Wald chi^2	9.11	9.11	9.11	5.18	5.18	5.18

Standard errors in parentheses; * p<0.10, ** p<0.05, *** p<0.01; z-score used for age

and those reported by Andersson et al. (2015) are small, and depend on subtle modeling choices (although the null-result for mixed prospects reported by Pahlke et al., 2010, appears more difficult to reconcile with the present findings). In the following section we attempt a similar reconciliation for gains, for which we have a richer set of studies.

3.3 Discussion: Reconciling previous findings for gains

In this section, we will try and take a closer look at the literature on risky gains and see to what extent those results are reconcilable with our findings. Table 6 summarizes the papers eliciting risk preferences in an individual condition and comparing them to decisions under responsibility under conditions of payoff equality. Next to the reference, we list the number of subjects, type of elicitation task, and the experimental design (within- or between-subjects). In terms of the between- versus within subject-design, we hypothezise that the latter is more likely to produce significant results, other things being equal, as it increases statistical power and may create contrast effects (Greenwald, 1978).

Most of the studies listed used intermediate probability gains. The exception to this rule in constituted by the studies employing the Holt & Laury choice lists, in which probabilities are varied within the list. Nevertheless, most people usually switch at intermediate probabilities in such choice lists. For gains obtaining with probabilities around 0.5, we find an increase in risk aversion under responsi-

Table 6: Overview of papers, effects of responsibility for gains

Reference	study nr./effect	task	design	S.s	significant
Bolton and Ockenfels (2010)	task 1 & 2	choice task	between-subjects	104	no
Pahlke et al. (2010)	exp. 1	choice task	between-subjects	96	yes
Pahlke et al. (2010)	exp. 2	choice task	between-subjects	120	yes
Humphrey and Renner (2011)	lottery, friends	Holt & Laury	between-subjects	98	no
Humphrey and Renner (2011)	lottery, strangers	Holt & Laury	between-subjects	100	no
Andersson et al. (2015)	utility	choice list	between-subjects	342	no
Bolton et al. (2015)	with info*	Holt & Laury	within-subjects	64	yes
Bolton et al. (2015)	without info*	Holt & Laury	within-subjects	64	yes

Nr. of subjects includes subjects in both treatments, but excludes purely passive recipients

* Pools decisions from a condition in which payoff equality and one with inverse payoff correlation

bility in the present paper, but since this increase derives from a rotation in the weighting function, it is relatively modest for a 50-50 probability. The strength of the effect may thus depend on the degree of risk aversion in the individual treatment, as well as the statistical power with which any differences are measured. Bolton and Ockenfels (2010) used choice tasks between a safe amount and a risky prospect. Since every subject just made one choice, they did not have much statistical power in their between-subjects design, nevertheless finding a significance level of $p = 0.125$ in favor of responsibility increasing risk aversion. Pahlke et al. (2010) found a significant effect for 50-50 probabilities with slightly lower subject numbers, also using a between-subjects design. This may, however, be due to the use of several different choice pairs per subject analyzed in a panel data probit structure, which is likely to boost statistical power. In their experiment 2 they used tasks offering a 90% chance of winning in the baseline, and again found responsibility to increase risk aversion (while finding responsibility to decrease risk aversion for a probability of 0.1). Humphrey and Renner (2011) found no difference between treatments using a Holt & Laury task.

Bolton et al. (2015) found significant effects of a responsibility treatment in two experimental conditions, one involving no information provided to the decision maker, and one in which the risk preferences of the passive recipient were communicated to the decision maker. They used in part a condition of payoff inequality, and in part one in which payoffs are negatively correlated, but pool these as they find no difference. Using the same type of Holt & Laury task employed by Humphrey and Renner (2011), they found a clear difference between treatments, going in the direction of more risk aversion by decision makers when they were responsible for somebody else. One of the reasons for which they find quite strong effects may be the within-subject design, which increases statistical power and may create a direct contrast between the individual choice tasks, always administered first, and the social responsibility condition. Overall, their results are thus not in contradiction to the ones found in this paper. The relation of these results to other decisions cited in the introduction is by necessity more speculative in nature, as those studies diverge from the setup used here along a number of dimensions. We will address this issue in the general discussion.

4 General discussion and conclusion

The evidence presented in this paper makes a clear case that probabilistic sensitivity is systematically affected when being responsible for somebody else. In particular, the decrease in probabilistic sensitivity found when a decision maker is responsible for somebody else's outcomes as well as her own results in an accentuation of risk seeking for small probability gains and large probability losses relative to the individual case, and to an accentuation of risk aversion for large probability gains and small probability losses. These effects appear to be highly consistent. They are also important from an economic point of view. The risk premium relative to the expected value for a typical large-probability prospect increases by about 5 percentage points under responsibility relative to individual decisions. For small probabilities, the relative risk premium is almost 19 percentage points lower under responsibility. And even for intermediate probabilities of 0.5, we still find the relative risk premium under responsibility to be 2.8 percentage points higher than for individual decisions.

Our findings also serves to organize a large part of the previous literature on responsibility under payoff equality. They correspond closely to the hypotheses formulated by Pahlke et al. (2010) based on a more restricted set of observations, showing that the effects are indeed systematic, and further serving to eliminate potential alternative explanations. At the same time, our results are consistent with the null results obtained by Bolton and Ockenfels (2010), Humphrey and Renner (2011), and Andersson et al. (2015) for moderate probability gains, since utility curvature is unaffected by the treatment and most of the action takes place for very small and very large probabilities. Finally, there is also some indication in the data of decreased loss aversion under responsibility, consistent with the recent findings by Andersson et al. (2015). We thus believe that the results presented in this paper constitute an important step towards the consolidation of the still relatively novel field of decisions under responsibility under conditions of payoff equality.

The obvious next question will be whether these insights can also organize results beyond the situation of payoff equality, and particularly whether they can be generalized to the type of agency situations involving asymmetrical payoffs briefly reviewed in the introduction. While we have no direct evidence to offer for that case, Andersson et al. (2015) did not find a significant difference between a symmetric payoffs treatment and one in which decision makers decide only for others. That also seems to agree with the finding of Bolton et al. (2015) according to which there is no difference between positively and negatively correlated payoffs under risk. That said, the agency literature differs from the one of payoff equality along a number of other dimensions, including the decision tasks used and the provision of information to the decision makers. Further research is thus needed to uncover potential sources of differences between the payoff equality literature and such agency situations.

One could also reconsider the effects of responsibility under the aspect of its power to reduce biases in decision making. In this respect, it is noteworthy that the responsibility seems to reduce loss aversion while increasing probability distortions and probabilistic insensitivity. Indeed, both ought to be considered biases if one assumes expected utility to be normative, as most people would Wakker (2010). While the contradictory effects may appear puzzling at first sight, they are nonetheless consistent with previous findings in the literature, which have found loss aversion to be volatile and easy to debias (List, 2004; Polman, 2012; Vieider, 2009), while probability distortions have proved much more elusive following some manipulations (Hsee and Rottenstreich, 2004; Pahlke et al., 2012; Rottenstreich and Hsee, 2001). The mechanisms underlying these differential effects remain largely unclear, and deserve further investigation.

References

Abdellaoui, Mohammed (2000) 'Parameter-free elicitation of utility and probability weighting functions.' *Management Science* 46(11), 1497–1512

Abdellaoui, Mohammed, Aurélien Baillon, Lætitia Placido, and Peter P. Wakker (2011) 'The rich domain of uncertainty : Source functions and their experimental implementation.' *American Economic Review* 101, 695–723

Abdellaoui, Mohammed, Han Bleichrodt, and Corina Paraschiv (2007) 'Loss aversion under prospect theory: A parameter-free measurement.' *Management Science* 53(10), 1659–1674

Abdellaoui, Mohammed, Han Bleichrodt, and Olivier L'Haridon (2008) 'A tractable method to measure utility and loss aversion under prospect theory.' *Journal of Risk and Uncertainty* 36(3), 245–266

Abdellaoui, Mohammed, Han Bleichrodt, Olivier L'Haridon, and Dennie Van Dolder (2013) 'Source-dependence of utility and loss aversion: A critical test of ambiguity models.' *University of Rennes 1 working paper*

Andersson, Ola, Håkan J. Holm, Jean-Robert Tyran, and Erik Wengström (2015) 'Deciding for others reduces loss aversion.' *Management Science, forthcoming*

Andersson, Ola, Jean-Robert Tyran, Erik Wengström, and Håkan J. Holm (2013) 'Risk aversion relates to cognitive ability: Fact or fiction?' *IFN Working Paper No. 964*

Apesteguia, José, and Miguel A. Ballester (2014) 'Discrete choice estimation of risk aversion.' *Working Paper*

Baltussen, Guido, Thierry Post, Martijn J. van den Assem, and Peter P. Wakker (2012) 'Random incentive systems in a dynamic choice experiment.' *Experimental Economics* 15(3), 418–443

Barberis, Nicholas C. (2013) 'Thirty years of prospect theory in economics: A review and assessment.' *Journal of Economic Perspectives* 27(1), 173–96

Barseghyan, Levon, Francesca Molinari, Ted O'Donoghue, and Joshua Teitelbaum (2013) 'The nature of risk preferences: Evidence from insurance choices.' *American Economic Review* 103(6), 2499–2529(31)

Bleichrodt, Han, and Jose Luis Pinto (2000) 'A parameter-free elicitation of the probability weighting function in medical decision analysis.' *Management Science* 46(11), 1485–1496

Bolton, Gary E, and Axel Ockenfels (2010) 'Risk taking and social comparison - a comment on "betrayal aversion: Evidence from brazil, china, oman, switzerland, turkey, and the united states".' *American Economic Review* 100(1), 628–633

Bolton, Gary E., Axel Ockenfels, and Julia Stauf (2015) 'Social responsibility promotes conservative risk behavior.' *European Economic Review* 74, 109–127

Bruhin, Adrian, Helga Fehr-Duda, and Thomas Epper (2010) 'Risk and rationality: Uncovering heterogeneity in probability distortion.' *Econometrica* 78(4), 1375–1412

Chakravarty, Sujoy, Glenn W Harrison, Ernan E Haruvy, and E. Elisabet Rutström (2011) 'Are you risk averse over other people' s money?' *Southern Economic Journal* 77(4), 901–913

Charness, Gary, and Matthew O Jackson (2009) 'The role of responsibility in strategic risk-taking.' *Journal of Economic Behavior & Organization* 69, 241–247

Cubitt, Robin P., Chris Starmer, and Robert Sugden (1998) 'On the validity of random lottery incentive systems.' *Experimental Economics* 1, 115–131

Diecidue, Enrico, and Jeroen van de Ven (2008) 'Aspiration level, probability of success and failure, and expected utility.' *International Economic Review* 49(2), 683–700

Eriksen, Kristoffer W., and Ola Kvaløy (2010) 'Myopic investment management.' *Review of Finance* 14(3), 521–542

Etchart-Vincent, Nathalie, and Olivier L'Haridon (2011) 'Monetary incentives in the loss domain and behavior toward risk: An experimental comparison of three reward schemes inclusing real losses.' *Journal of Risk and Uncertainty* 42, 61–83

Fehr-Duda, Helga, Adrian Bruhin, Thomas F. Epper, and Renate Schubert (2010) 'Rationality on the rise: Why relative risk aversion increases with stake size.' *Journal of Risk and Uncertainty* 40(2), 147–180

Fehr, Ernst, and Klaus M. Schmidt (1999) 'A theory of fairness, competition, and cooperation.' *The Quarterly Journal of Economics* 114(3), 817–868

Gächter, Simon, Eric J. Johnson, and Andreas Herrmann (2010) 'Individual-level loss aversion in riskless and risky choices.' Technical Report 2010-20, CeDEx discussion paper series

Gneezy, Uri, and Jan Potters (1997) 'An experiment on risk taking and evaluation periods.' *The Quarterly Journal of Economics* 112(2), 631 – 45

Goldstein, William M., and Hillel J. Einhorn (1987) 'Expression theory and the preference reversal phenomena.' *Psychological Review* 94(2), 236–254

Greenwald, Anthony G. (1978) 'Within-subject designs: To use or not to use?' *Psychological Bulletin* pp. 314–320

Hey, John D., and Chris Orme (1994) 'Investigating generalizations of expected utility theory using experimental data.' *Econometrica* 62(6), 1291–1326

Holt, Charles A., and Susan K. Laury (2002) 'Risk aversion and incentive effects.' *American Economic Review* pp. 1644–1655

Hsee, Christopher, and Yuval Rottenstreich (2004) 'Music, pandas, and muggers: On the affective psychology of value.' *Journal of Experimental Psychology: General* 133(1), 23–30

Humphrey, Steven J., and Elke Renner (2011) 'The social cost of responsibility.' *CeDEx discussion paper 2011-02*

Kachelmeier, Steven J., and Mohamed Shehata (1992) 'Examining risk preferences under high monetary incentives: Experimental evidence from the people's republic of china.' *American Economic Review* 82(5), 1120–1141

Kahneman, Daniel, and Amos Tversky (1979) 'Prospect theory: An analysis of decision under risk.' *Econometrica* 47(2), 263 – 91

Kilka, Michael, and Martin Weber (2001) 'What determines the shape of the probability weighting function under uncertainty?' *Management Science* 47(12), 1712–1726

Köbberling, Veronika, and Peter P. Wakker (2005) 'An index of loss aversion.' *Journal of Economic Theory* 122(1), 119 – 131

Kőszegi, Botond, and Matthew Rabin (2007) 'Reference-dependent risk attitudes.' *The American Economic Review* 97(4), 1047–1073

Lattimore, Pamela M., Joanna R. Baker, and Anna D. Witte (1992) 'The influence of probability on risky choice.' *Journal of Economic Behavior & Organization* 17, 377–400

Lefebvre, Mathieu, Ferdinand M. Vieider, and Marie Claire Villeval (2010) 'Incentive effects on risk attitude in small probability prospects.' *Economics Letters* 119, 115–120

List, John A. (2004) 'Neoclassical theory versus prospect theory: Evidence from the marketplace.' *Econometrica* 72(2), 615 – 625

Markowitz, Harry (1952) 'The utility of wealth.' *Journal of Political Economy* 60(2), 151–158

Pahlke, Julius, Sebastian Strasser, and Ferdinand M. Vieider (2010) 'Responsibility effects in decision making under risk.' *Munich Discussion Paper No. 2010-37*

_ (2012) 'Risk-taking for others under accountability.' *Economics Letters* 114(1), 102–105

Pollmann, Monique M. H., Jan Potters, and Stefan T. Trautmann (2014) 'Risk taking by agents: The role of ex-ante and ex-post accountability.' *Economics Letters* 123(3), 387–390

Polman, Evan (2012) 'Self–other decision making and loss aversion.' *Organizational Behavior and Human Decision Processes* 119(2), 141–150

Prelec, Drazen (1998) 'The probability weighting function.' *Econometrica* 66, 497–527

Reynolds, Douglas B., Jacob Joseph, and Reuben Sherwood (2009) 'Risky shift versus cautious shift: Determining differences in risk taking between private and public management decision making.' *Journal of Business and Economics Research* 7(1), 63–77

Rottenstreich, Yuval, and Christopher K. Hsee (2001) 'Money, kisses, and electric shocks: On the affective psychology of risk.' *Psychological Science* 12(3), 185–190

Schmidt, Ulrich, and Horst Zank (2005) 'What is loss aversion?' *Journal of Risk and Uncertainty* 30(2), 157–167

Starmer, Chris (2000) 'Developments in non-expected utility theory: The hunt for a descriptive theory of choice under risk.' *Journal of Economic Literature* 38, 332–382

Stott, Henry P. (2006) 'Cumulative prospect theory's functional menagerie.' *Journal of Risk and Uncertainty* 32, 101–130

Sugden, Robert (2003) 'Reference-dependent subjective expected utility.' *Journal of Economic Theory* 111(2), 172–191

Sutter, Matthias (2009) 'Individual behavior and group membership: Comment.' *American Economic Review* 99(5), 2247–2257

Tanaka, Tomomi, Colin F. Camerer, and Quang Nguyen (2010) 'Risk and time preferences: Linking experimental and household survey data from vietnam.' *American Economic Review* 100(1), 557–571

Train, Kenneth (2009) *Discrete choice methods with simulation* (Cambridge; New York: Cambridge University Press)

Trautmann, Stefan T., and Ferdinand M. Vieider (2012) 'Social influences on risk attitudes: Applications in economics.' In *Handbook of Risk Theory,* ed. S. Roeser (Springer) pp. 225–243

Tversky, Amos, and Daniel Kahneman (1992) 'Advances in prospect theory: Cumulative representation of uncertainty.' *Journal of Risk and Uncertainty* 5, 297–323

Tversky, Amos, and Peter P. Wakker (1995) 'Risk attitudes and decision weights.' *Econometrica* 63(6), 1255–1280

Vieider, Ferdinand M. (2009) 'The effect of accountability on loss aversion.' *Acta psychologica* 132(1), 96–101

Vieider, Ferdinand M., Mathieu Lefebvre, Ranoua Bouchouicha, Thorsten Chmura, Rustamdjan Hakimov, Michal Krawczyk, and Peter Martinsson (2014) 'Common components of risk and uncertainty attitudes across contexts and domains: Evidence from 30 countries.' *Journal of the European Economic Association, forthcoming*

von Gaudecker, Hans-Martin, Arthur van Soest, and Erik Wengström (2011) 'Heterogeneity in risky choice behaviour in a broad population.' *American Economic Review* 101(2), 664–694

Wakker, Peter P. (2008) 'Explaining the characteristics of the power (CRRA) utility family.' *Health Economics* 17(12), 1329–1344

_ (2010) *Prospect Theory for Risk and Ambiguity* (Cambridge: Cambridge University Press)

Wilcox, Nathaniel T. (2011) ''stochastically more risk averse:' a contextual theory of stochastic discrete choice under risk.' *Journal of Econometrics* 162(1), 89–104

Wu, George, and Richard Gonzalez (1996) 'Curvature of the probability weighting function.' *Management Science* 42(12), 1676–1690

Zeisberger, Stefan, Dennis Vrecko, and Thomas Langer (2012) 'Measuring the time stability of prospect theory preferences.' *Theory and Decision* 72(3), 359–386

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WZB Junior Research Group: **Risk and Development**

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Risk taking for oneself and others: A structural model approach