

INEQUALITIES UNDER AMBIGUITY

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JEL Classification: D80, D81

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Inequalities under Ambiguity

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Abstract

This paper explores the impact of risk and ambiguity on wealth redistribution, using an experimental dictator game. The findings show that wealth redistribution significantly declined in line with increased perceived risk, suggesting that heightened risk and ambiguity may reduce altruistic behavior. Gender differences in risk aversion were observed under conditions of risk (characterized by well-defined probability), but vanished under conditions of ambiguity. The study highlights the importance of risk perception in shaping social preferences and the potential use of ambiguity as a moral rationale to avoid engagement in pro-social behaviors and wealth redistribution.

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Conflict of Interests: The authors declare no competing interests.

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1. Introduction

In a world that is constantly changing and evolving, risk and ambiguity play crucial roles in the determination of economic progress. Questions about future income and the accuracy of forecasts are becoming increasingly relevant, while concepts of guaranteed earnings and opportunities are becoming increasingly remote and impractical. The idea that we can precisely determine the objective probability of future events is not realistic. All aspects of life are influenced by ambiguous levels of risk, and individuals base their actions on their estimates of perceived risk. With regards to wealth, this implies that ambiguity affects not only the total amount of global wealth, but also its distribution.

When considering the redistribution of individual wealth within society, those facing potential losses may develop an aversion to this practice, representing an anti-social attitude. There are two reasons for this. First, the transfer of wealth is inherently risky and ambiguous. Historically, there have been numerous instances of both unsuccessful donations (Brañas-Garza, 2007) and inefficient wealth transfers, such as those characterized by tax payments (Alesina and Angeletos, 2005; Jakiela, 2013). Research suggests that the perceived riskiness of wealth transfer often serves as a moral rationale for refraining from wealth redistribution, thus fostering anti-social preferences (Cettolin et al., 2017). In this scenario, the aversion to wealth redistribution may be attributable to individual levels of risk aversion. Second, anti-social preferences may derive from a risk to personal income. Faced with ambiguity regarding their own finances, individuals are less likely to transfer wealth, as their own earnings are at stake (Cettolin et al., 2017; Garcia et al., 2020).

In the realm of experimental economics, the dictator game has been used to study altruistic and redistributive behaviors (List, 2007; Engel, 2011). In this game, a participant (i.e., the "giver") must decide whether and how to allocate a sum of money to another participant (i.e., the "receiver" or "beneficiary"), who has no influence over the giver's decision. This setup aims at revealing individual attitudes towards justice and equity in the distribution of wealth (Schurter and Wilson, 2009). Previous research has employed the dictator game to investigate the willingness of individuals, devoid of incentives, to part with a portion of their wealth for redistributive purposes. Engel (2011) provided a comprehensive review of the factors that encourage strong social preferences, in support of altruistic and pro-redistributive actions. However, the roles played by risk and ambiguity in this domain remain relatively underexplored (Haisley and Weber, 2010; Brock et al., 2013; Cettolin et al., 2017; Garcia et al., 2020). Notably, Cettolin et al. (2017) illustrated that conditions of risk may influence the two stylized aspects introduced above: i) when the risk is experienced by the "giver" or ii) when the risk is experienced by the "recipient." This suggests a correlation between social preferences and attitudes towards risk and ambiguity.

While the authors of the aforementioned study highlighted the importance of further research, their study nonetheless allowed for a preliminary investigation of the potential role played by ambiguity in shaping social preferences and attitudes towards wealth distribution. First, the authors introduced ambiguity by reporting the multiplier of the monetary amount that could be used to infer the objective probabilities associated with the riskiness of the choice, rather than the actual probabilities, themselves. This may be clarified using a practical example drawn from their design: In a specific decision-making scenario characterized by risk, subjects were tasked with determining the amount they wished to transfer. The amount designated for donation (x) had a 50% chance of being increased by a factor of 1.5 and a 50% chance of being halved. The expected donation value for a risk-neutral subject was x —exactly what subjects would have donated in the absence of risk (i.e., the certain case). By incorporating ambiguity, the authors introduced an undefined probability p , whereby subjects received $1.5x$ with probability p and $0.5x$ with probability $1-p$. If subjects understood how the experimenter calibrated the probabilities, they could infer that the expected value remained constant, and therefore the only probability that resolved $x = p(1+p)x + p(1-p)x$ was $p=0.5$. Thus, ambiguity reduced to risk.

In the present study, we introduced ambiguity by adding a layer of realism, akin to real-life risky situations. That is, subjects were given the opportunity to infer probabilities with no explicit hints as to their real values. In our perspective, this approach brought the experimental condition in line with daily decision-making, wherein individuals assess subjective risk not from a totally uninformed prior distribution, but with some intuitive sense of the likelihood of various outcomes. Moreover, we broadened the concept of ambiguity by integrating it into subjects' probability estimates. In more detail, subjects had the opportunity to deduce the correct probabilities by analyzing the events presented in the “ambiguity box” (Caferra et al., 2023; Morone and Caferra, 2024)—an innovative tool for the analysis of decision-making under conditions of ambiguity. Consequently, by analyzing giving behavior in the context of both risk and ambiguity, the present study represented an original contribution to the literature on giving under conditions of risk (Cettolin et al., 2017).

The experimental setup proposed a real-life scenario in which subjects could estimate event probabilities (i.e., ambiguity) and compare these with a scenario in which all probabilities were objective and well-defined (i.e., risk). This was interesting for two reasons: first, it allowed us to explore the importance of contextual characteristics in decision-making, comparing more or less risky and ambiguous economic scenarios; and second, it allowed us to study the individual attitudes that best explained the observed phenomena. For the latter, we estimated the parameters of risk aversion and ambiguity aversion using α -maxmin functional preferences and identified the socio-demographic characteristics that most influenced subjects' decision-making. For example, while extensive research has provided support for a gender effect in

risk aversion, there is a growing body of evidence showing that this effect disappears as conditions move from risk to ambiguity, suggesting the latter condition's broader scope (Sarin and Wieland, 2016).

The present study considered all of these aspects. In the remainder of the paper, Section 2 explains the relevant aspects of the proposed experimental design, Section 3 presents the results and Section 4 provides concluding remarks.

2. Theory and Design

In March 2024, we conducted an experiment involving 84 students from the University of Bari in Italy. The study was divided into two separate sessions, employing a within-subject design and utilizing the Qualtrics platform for implementation. Participants were informed that one experimental currency unit (ECU) was equivalent to one euro, and selections from all treatments would be eligible for payment at the experiment's conclusion, with one decision selected for the payment. The experiment lasted approximately 40 minutes, and the average payment was approximately 6 euros.

This section presents the key experimental and theoretical components of the study, which was organized into two distinct phases. During the first phase, participants engaged in the dictator game under conditions of i) ambiguity, ii) risk and iii) certainty. Following the traditional format of the game, subjects were anonymously paired, and the roles of giver and beneficiary were randomly assigned in each pair. In the second phase, subjects engaged in an allocation game under conditions of ambiguity, and estimations of their α -maxmin preference functions were derived.

2.1. Phase 1: Dictator Game

For the first phase, we revisited the framework introduced by Cettolin et al. (2017) to identify choices in which risk was shifted to either the giver or the beneficiary—corresponding to the Risk-G and Risk-B treatments, respectively, of the referenced experimental design. Table 1 displays the objective probabilities of the different scenarios, accounting for situations in which the risk or ambiguity was borne by one of the two parties. This framework established a baseline scenario, while the generic formula for risky cases was $p: (1+p)x$ and $(1-p): (1-p)x$, or $p: (1/p)x$ and $(1-p): 0x$. This means that, with probability p , a subject received $(1+p)x$; and with probability $(1-p)$, she/he received $(1-p)x$. This example is helpful for understanding the formulation in Table 1. Risk-neutral subjects were characterized by $x=p(1+p)x+p(1-p)x$, equating to the same amount donated as in a no-risk scenario (as on the left side of the equation) for either the Risk-B ($X-x$) or the Risk-G scenario (x).

For the condition of ambiguity, we reintroduced the risk scenarios, with p representing the number of blue squares in the ambiguity box (expressing the probability that a square of that color would be extracted). To compare treatments, when constructing the ambiguity boxes we set p equal to the treatment values under the condition of risk (0.5, 0.5, 0.8, 0.2). The experimenter knew the actual number of squares, while subjects could only estimate this number (as discussed in the following section). This introduced an element of ambiguity.

Certainty				
	Giver	Beneficiary	Giver	Beneficiary
0-Certainty	$X-x_0$	x_0	$X-x_0$	x_0

	Risk-B		Risk-G	
	Giver	Beneficiary	Giver	Beneficiary
1-objective risk	$X-x_1$	0.5: 1.5 x_1 ; 0.5: 0.5 x_1	0.5: 1.5($X-x_1$); 0.5: 0.5($X-x_1$)	x_1
2-objective risk	$X-x_2$	0.8: 1.25 x_2 ; 0.2: 0 x_2	0.8: 1.25($X-x_2$); 0.2: 0($X-x_2$)	x_2
3-objective risk	$X-x_3$	0.5: 2 x_3 ; 0.5: 0 x_3	0.5: 2($X-x_3$); 0.5: 0($X-x_3$)	x_3
4-objective risk	$X-x_4$	0.2: 5 x_4 ; 0.8: 0 x_4	0.2: 5($X-x_4$); 0.8: 0($X-x_4$)	x_4

	Ambiguity-B		Ambiguity-G	
	Giver	Beneficiary	Giver	Beneficiary
1-objective risk	$X-x_1$	$p: (1+p)x_1; p: (1-p)x_1$	$p: (1+p)(X-x_1); (1-p): 0(X-x_1)$	x_1
2-objective risk	$X-x_2$	$p: (1/p)x_2; (1-p): 0x_2$	$p: (1/p)(X-x_2); (1-p): 0(X-x_2)$	x_2
3-objective risk	$X-x_3$	$p: (1/p)x_3; (1-p): 0x_3$	$p: (1/p)(X-x_3); (1-p): 0(X-x_3)$	x_3
4-objective risk	$X-x_4$	$p: (1/p)x_4; (1-p): 0x_4$	$p: (1/p)(X-x_4); (1-p): 0(X-x_4)$	x_4

Table 1. Dictator game under conditions of certainty (top), risk (middle) and ambiguity (bottom).

Dictator Game under Conditions of Ambiguity

First, subjects were presented with eight prospects related to ambiguity (i.e., four cases for Ambiguity-B, four for Ambiguity-G; see Table 1), in a randomized order. The ambiguity box was used to introduce ambiguity. Specifically, the box contained 100 squares of two colors (red and blue) in continuous motion. The number of squares of each color remained constant within the same decision problem but varied across problems. This ensured a constant and underlying objective probability. The continuous motion of squares made it challenging for subjects to count the exact number of squares of each color, thereby inducing ambiguity. After subjects made their decisions, a random extraction of one square (using the underlying probabilities chosen by the experimenter) determined the decision payoff.

Subjects were thus able to estimate a subjective probability, starting from a prior distribution that proved informative. In other words, if the distribution of probabilities was 80–20%, subjects could not ascertain the exact probability value, but they could develop a vague sense of which event was more likely. The objective probability at which the event occurred remained unknown or difficult to calculate, enhancing the realism of the experimental setup. Figure 1 presents a static snapshot of the ambiguity box.

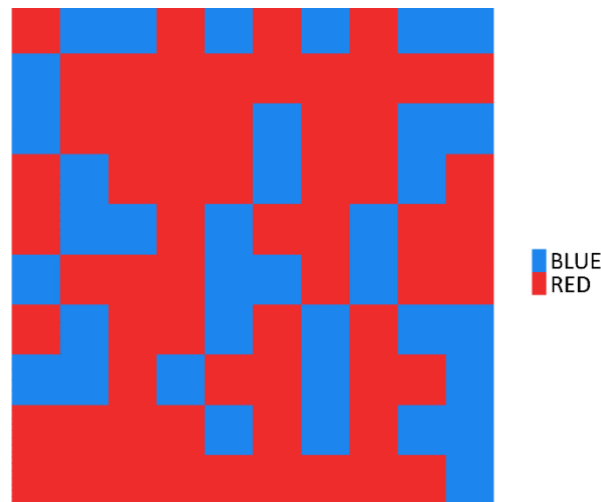


Figure 1. Static version of the ambiguity box.

In each treatment, subjects were informed that the probability p represented the likelihood of extracting a blue square from the box (see the Appendix for an example of the decision screen). Additionally, they were provided with the multiplier to be applied to the endowment transferred or not transferred as a function of p , as reported in Table 1. Therefore, they had to infer the probability.

To facilitate subjects' comprehension of the mathematics behind each treatment, the following table was projected in the laboratory during the experiment.

No. blue squares	p	$1/p$
10	0.1	10.00
15	0.15	6.67
20	0.2	5.00
25	0.25	4.00
30	0.3	3.33
35	0.35	2.86
40	0.4	2.50
45	0.45	2.22
50	0.5	2.00

No. blue squares	p	$1/p$
60	0.6	1.67
65	0.65	1.54
70	0.7	1.43
75	0.75	1.33
80	0.8	1.25
85	0.85	1.18
90	0.9	1.11
95	0.95	1.05
100	1	1.00

Table 2. Table with portions and inverse values for the dictator game under ambiguity.

Dictator Game under Conditions of Risk

In the second part of the experiment, subjects were tasked with making decisions regarding different risky prospects with objective probabilities, and were provided with the probabilities of each event (see the Appendix for an example of the decision screen). To prevent a learning bias related to knowledge of the true probability, we randomized the order in which the different prospects appeared, and presented all risky decisions after the ambiguous model.

Dictator Game under Conditions of Certainty

Finally, subjects were instructed to allocate their money following the standard protocol of the dictator game. Therefore, neither the amount transferred nor the amount not transferred was subject to objective risk.

2.2. Phase 2: Allocation game

Subsequent to the dictator game, subjects engaged in 40 allocation decisions. These decisions were used to estimate their α -maxmin expected utility functional preferences (Caferra et al., 2023). For each decision, subjects allocated 10 ECU between blue and red options, while observing animated squares in the ambiguity box. Ultimately, one of the two events was drawn according to the underlying probabilities.

Recalling the main aspects, if the true probability of an event was p , we assumed that the minimum perceived probability for this event was $p - \delta$ and the maximum perceived probability was $p + \delta$, with δ identifying the degree of ambiguity about the true probability. In our estimation, α was a measure of ambiguity aversion. We assumed it to be individual-specific, and estimated its value on a subject by subject basis. We adopted a constant relative risk aversion (CRRA) utility function (as in Hey and Panaccione, 2011), with a constant risk aversion parameter (ra) in the utility function (u) and objective probabilities for the outcomes $p_1 < p_2$. The following objective function was maximized:

$$\max_{x_i} \quad \alpha \min_{p_j} \sum_{j=1}^2 (p_j - \delta) u(x_i) + (1 - \alpha) \max_{p_j} \sum_{j=1}^2 (p_j + \delta) u(x_i) \quad \text{s.t.} \quad \sum_{i=1}^2 x_i = m$$

Where m was the endowment, x_1 was the portion allocated to the blue outcome and $x_2 = 1 - x_1$ was the portion allocated to the red one. This structure enabled us to estimate key choice parameters (i.e., risk aversion, ambiguity aversion). We conducted intensive simulations in MATLAB to identify the optimal problem set for determining the true parameters (see the Appendix for details).

3. Results

Table 3 reports the results of the dictator game. Following the traditional game structure, half of the sample was designated as giver/beneficiary. Within the complete set of subjects, 59% were female—a characteristic we utilized, as previously mentioned, to explore a potential gender effect on transfer choices. Additionally, Table 3 presents the average values and standard deviations for the transfer amounts, alongside the percentages of selfish decisions (i.e., “%Selfish”). To generate these values, we discretized the distribution of choices into 10 classes and assigned 1 to choices belonging to the lowest class (1st decile, $ECU \leq 1$).

Generally, we observed that, as prospect risk increased, the likelihood of selfish behavior rose, thereby lowering the inclination towards wealth redistribution, regardless of whether the prospect was ambiguous or risky and whether the certainty of gains referred to the giver or the beneficiary.

0-certainty	Average (sd)		2.64 (2.26)	%Selfish		38%
	Risk-B			Risk-G		
	Average (sd)		%Selfish	Average (sd)		%Selfish
1-objective risk	3.21	2.85	33%	3.03	2.47	35%
2-objective risk	3.26	2.53	33%	2.75	2.22	38%
3-objective risk	2.09	2.11	47%	2.32	2.07	45%
4-objective risk	2.48	2.57	52%	2.61	2.13	38%
	Ambiguity-B			Ambiguity-G		
	Average (sd)		%Selfish	Average (sd)		%Selfish
1-objective risk	3.06	2.52	29%	3.43	2.83	31%
2-objective risk	3.35	2.54	31%	3.15	2.60	36%
3-objective risk	3.11	2.90	36%	2.73	2.44	37%
4-objective risk	3.11	3.18	43%	2.51	2.70	44%

Table 3. Summary statistics.

Table 4 presents the estimations of the risk and ambiguity aversion parameters that were used for the subsequent analysis.

	Mean	SD
α (ambiguity aversion)	0.59	0.24
ρ_a (risk aversion)	0.65	0.42

Table 4. Ambiguity and risk aversion estimations.

Given the aforementioned observations, we formalized the analysis using an econometric estimation model. Data were treated in a panel format with repeated observations per subject, controlling for the presence of fixed effects. Two types of response variables were used: i) the choice made and ii) the probability of being selfish (“selfish”). In the latter case, we used a random effects panel probit. The basic model could be expressed as follows:

$$Transfer_{i,t} = \beta_0 + \beta_1 Riskiness_{i,t} + \beta_2 \alpha_i + \beta_3 ra_i + \beta_4 Female_i + \beta_5 Risk_{i,t} + \beta_6 Ambiguity_{i,t} + \beta_7 Shift + u_i + \epsilon_i$$

where *transfer* was the level of transferred wealth (i.e., the transfer choice) for individual *i* in decision *t*; *riskiness_{i,t}* was the level of risk in the situation (i.e., objective probabilities) for treatment *t*, as indicated in the row names of Table 2 (0-certainty, 1-objective risk, 2-objective risk, 3-objective risk, 4-objective risk, 5-objective risk); and α and *ra* were the parameters of ambiguity and risk aversion, respectively, for individual *i*. *Female_i* was a dummy variable for gender (i.e., 1=female; 0=non-female) for individual *i*. *Risk* was a dummy variable controlling for decisions made under conditions of risk, and *ambiguity* controlled for decisions made under conditions of ambiguity. *Shift* referred to the shift of risk/ambiguity (i.e., 0 for a certain case, 1 for beneficiary risk/ambiguity, 2 for giver risk/ambiguity). Therefore, greater *shift* values indicated the greater proximity of risk/ambiguity to the decision-maker (i.e. the giver). Finally, $u_{i,t}$ was the individual-specific random effect, ϵ_i was the error term and $\beta_0, \beta_1, \beta_2, \beta_3, \beta_4, \beta_5, \beta_6, \beta_7$ were the coefficients to be estimated.

To account for the higher heterogeneity of decisions (as also noted by Cettin et al. 2017), we introduced a dummy variable, assigning a value of 1 for selfish subjects (i.e., exhibiting low levels of giving, $ECU \leq 1$) and 0 for non-selfish subjects. The resulting random effects probit model could be expressed as follows:

$$Selfish_{i,t} = \beta_0 + \beta_1 Riskiness_{i,t} + \beta_2 \alpha_i + \beta_3 ra_i + \beta_4 Female_i + \beta_5 Risk_{i,t} + \beta_6 Ambiguity_{i,t} + \beta_7 Shift + u_i + \epsilon_i$$

where the meaning of the regressors was the same as above. Following a category-based approach, we also split the sample, considering the dynamics under conditions of risk and ambiguity, and disentangled the sample considering the different cases of risk/ambiguity shift from the giver to the beneficiary (i.e., Risk-B, Risk-G, Ambiguity-B, Ambiguity-G). Table 5 presents the results of the random effects model where the response variable was the level of wealth transferred for redistribution, while Table 6 reports the coefficients of the probit model examining the relationship between the probability of observing selfish behavior (and thus antisocial preferences) based on different regressors. Of note, the analysis of average effects (Table 5) yielded similar, though not identical, results compared to the analysis conducted on the probability of extreme values (Table 6).

Table 5 presents the basic model in the first column, while the subsequent columns employ a category-based approach, referring to specific treatment conditions. The second column combines all

treatments under conditions of risk, while column three groups all treatments under conditions of ambiguity. Columns four to seven make further divisions, considering not only the treatment condition of risk or ambiguity, but also which of the two subjects (i.e., Giver-B or Beneficiary-B) assumed the risk. A certain treatment was always included as the baseline, following Cettolin et al. (2017).

As can be observed from the first column, the riskier the prospect, the greater the aversion to wealth transfer. This trend became more pronounced in columns two and three, particularly for treatments under conditions of risk. Later, we will explore how the results changed when considering the probability of extreme values. In treatments under conditions of ambiguity, greater aversion to ambiguity was associated with a lower propensity to donate, as well as an aversion to risk. However, this effect was modest and not statistically significant, suggesting that contextual characteristics (e.g., prospect risk) may exert a greater influence than individual traits (e.g., attitudes towards risk). Another important effect pertained to gender. Following the literature, women were generally more risk-averse when the risk was identifiable (i.e., Risk-B, Risk-G). However, this gender effect disappeared under conditions of ambiguity (i.e., Ambiguity-B, Ambiguity-G).

Considering average values, the effect of ambiguity seemed more pronounced when the objective risk of the prospect had the potential to adversely impact the dictator's wealth, while the opposite held true under conditions of risk.

	Full	Risk	Ambiguity	Risk-B	Ambiguity-B	Risk-G	Ambiguity-G
	Transfer	Transfer	Transfer	Transfer	Transfer	Transfer	Transfer
Riskiness	-.207*** (.063)	-.176*** (.058)	-.066 (.096)	-.333** (.141)	-.009 (.163)	-.166 (.114)	-.319* (.166)
Alpha	-.019 (.985)	.748 (1.051)	-.803 (1.251)	1.33 (1.144)	-.505 (1.68)	.468 (1.038)	-1.168 (1.228)
Ra	.161 (.528)	.067 (.524)	.243 (.637)	.099 (.575)	.407 (.677)	.042 (.558)	.125 (.709)
Risk	.808* (.485)						
Ambiguity	1.141* (.561)						
Female	-.837* (.464)	-1.272** (.519)	-.407 (.559)	-1.37** (.596)	-.189 (.762)	-1.308** (.522)	-.546 (.586)
Shift	-.138 (.212)	.126 (.143)	.092 (.214)			1.186*** (.29)	1.562*** (.352)
Constant	3.185*** (.846)	3.076*** (.871)	3.498*** (.971)	3.559*** (.901)	3.324*** (1.107)		
Observations	712	376	378	168	168	166	168
Pseudo R ²	0.039	0.072	0.015	0.09	0.014	0.089	0.045

Note. Robust standard errors in parentheses.

*** $p < .01$, ** $p < .05$, * $p < .1$.

Table 5. Random effect regression model. Average effect.

As anticipated, the analysis of extreme values yielded additional insights that were not otherwise apparent from the average effects. The findings aligned with those of Cettolin et al. (2017), regarding the heterogeneity of subject behavior. The exercise also served to mitigate the erratic component of choices made on a continuous scale by discretizing the distribution and analyzing the extreme category—that of subjects exhibiting extremely selfish behavior.

As is evident in Table 6, the effect of prospect risk was more pronounced under conditions of ambiguity. The riskiness variable exhibited an effect only when the risk was assumed by the beneficiary (Risk-B), while it was consistently positive and statistically significant under conditions of ambiguity. The gender effect remained consistent with the findings from the analysis of average effects.

	Full	Risk	Ambiguity	Risk-B	Ambiguity-B	Risk-G	Ambiguity-G
	Selfish	Selfish	Selfish	Selfish	Selfish	Selfish	Selfish
Riskiness	.194*** (.054)	.214*** (.069)	.145** (.067)	.472*** (.161)	.297* (.165)	.07 (.127)	.233** (.116)
Alpha	-.575 (.867)	-1.04 (1.227)	-.64 (1.013)	-1.975 (1.543)	-.993 (1.764)	-.661 (1.201)	-.374 (1.251)
Ra	.129 (.479)	.079 (.695)	.137 (.6)	-.093 (.861)	-.142 (.744)	.186 (.713)	-.036 (.835)
Risk	-.341 (.325)						
Ambiguity	-.562 (.432)						
Female	.848** (.421)	1.466** (.637)	.681 (.512)	1.568* (.81)	.695 (.875)	1.42** (.672)	.583 (.662)
Shift	-.015 (.163)	-.194 (.186)	-.105 (.167)				
Constant	-.733 (.745)	-.754 (1.025)	-.834 (.819)	-1.327 (1.169)	-1.374 (1.302)	-1.264 (1.009)	-1.394 (1.021)
Observations	714	378	378	168	168	168	168
ll	-352.835	-172.041	-187.246	-81.028	-78.57	-84.541	-85.679

Note. Robust standard errors in parentheses

*** $p < .01$, ** $p < .05$, * $p < .1$.

Table 6. Random effect probit model.

To complete the analysis, Figure 2 reports the marginal effects of the riskiness and gender (Female=1) variables. As is evident, riskiness was significant in explaining an increase in the likelihood of selfish behavior, and the gender effect disappeared under conditions of ambiguity.

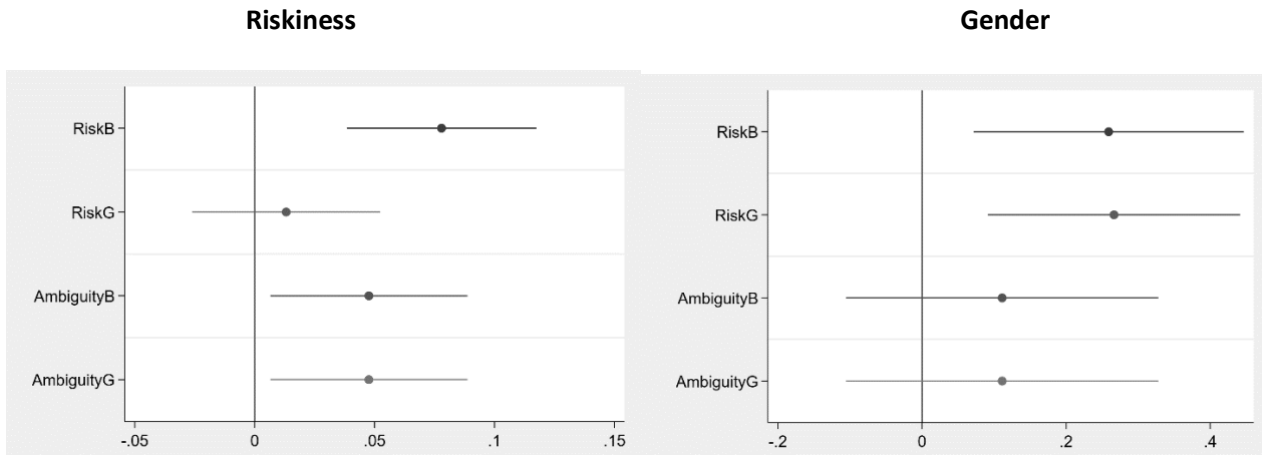


Figure 2. Marginal effects of prospect riskiness (left) and fender (female=1; right). Confidence intervals at 90%.

4. Conclusions

The present results suggest that risk and ambiguity may play important roles in shaping preferences for wealth redistribution. On the one hand, individuals may develop an aversion to wealth transfer if attempts at wealth transfer are deemed unsuccessful. This might orient them towards efficiency and away from the redistribution of resources. On the other hand, a similar aversion may arise under conditions in which the retention of wealth is deemed riskier or more ambiguous than its transfer.

On this basis, individuals might refer to the ambiguity and risk associated with the outcome of a donation as a moral justification for refraining from donation (Garcia, 2020). They may also exhibit an aversion to wealth redistribution, seeking compensation for the ambiguous situation—even when, from a social welfare perspective, their donation will yield a certain outcome. We could thus conclude that the presence of risk and ambiguity diminishes social preferences for high levels of risk and ambiguity, extending the results of Cettolin et al. (2017). This might significantly impact individual attitudes towards resource redistribution, possibly hindering the mitigation of social inequalities.

In our experimental setup, the introduction of ambiguity added a layer of realism to the decision-making context. Additionally, the ambiguity box effectively reproduced this scenario, not only underscoring the underlying risk effect of the specific decision, but also rendering the risk effect more salient by cancelling out potential gender differences (Sarin and Wieland, 2016), making the outcome more generalizable.

Conflict of Interests: The authors declare no competing interests.

References

- Alesina, A., & Angeletos, G. M. (2005). Fairness and redistribution. *American Economic Review*, 95(4), 960–980.
- Brañas-Garza, P. (2007). Promoting helping behavior with framing in dictator games. *Journal of Economic Psychology*, 28(4), 477–486.
- Brock, J. M., Lange, A., & Ozbay, E. Y. (2013). Dictating the risk: Experimental evidence on giving in risky environments. *American Economic Review*, 103(1), 415–437.
- Caferra, R., Hey, J. D., Morone, A., & Santorsola, M. (2023). Dynamic inconsistency under ambiguity: An experiment. *Journal of Risk and Uncertainty*, 67(3), 215–238.
- Cettolin, E., Riedl, A., & Tran, G. (2017). Giving in the face of risk. *Journal of Risk and Uncertainty*, 55, 95–118.
- Engel, C. (2011). Dictator games: A meta study. *Experimental Economics*, 14, 583–610.
- Garcia, T., Massoni, S., & Villeval, M. C. (2020). Ambiguity and excuse-driven behavior in charitable giving. *European Economic Review*, 124, 103412.
- Haisley, E. C., & Weber, R. A. (2010). Self-serving interpretations of ambiguity in other-regarding behavior. *Games and Economic Behavior*, 68(2), 614–625.
- Jakiela, P. (2013). Equity vs. efficiency vs. self-interest: On the use of dictator games to measure distributional preferences. *Experimental Economics*, 16, 208–221.
- List, J. A. (2007). On the interpretation of giving in dictator games. *Journal of Political Economy*, 115(3), 482–493.
- Morone, A., & Caferra, R. The ambiguity box: A new tool to generate ambiguity in the lab. Available at SSRN 4700547.
- Sarin, R., & Wieland, A. (2016). Risk aversion for decisions under uncertainty: Are there gender differences?. *Journal of Behavioral and Experimental Economics*, 60, 1–8.
- Schurter, K., & Wilson, B. J. (2009). Justice and fairness in the dictator game. *Southern Economic Journal*, 76(1), 130–145.

A. Appendix

A.1. Decision Screen of the Dictator Game

Here we provide some examples of the dictator game decision screens under conditions of risk and ambiguity.

Dictator Game under Conditions of Ambiguity

Considering the treatment condition with lower objective risk, we report an example of the text entered on the decision screen:

Risk to the giver:

"You have been allocated 10 ECU. You must decide how many of the 10 ECU to transfer to individual B.

In the box, there are red and blue squares, totaling 100 squares. The squares are continuously moving, but the number of squares of each color is constant. Let p be the portion of blue squares (i.e., the number of blue squares divided by 100). The subject will receive:

- The amount allocated for the transfer multiplied by $(1+p)$ if a blue square is drawn;*
- The amount allocated for the transfer multiplied by p if a red square is drawn.*

Your gain will be 10 ECU minus the amount you do not allocate for the transfer.

Decide how much you want to transfer to the other subject (use the . as the decimal separator)."

Risk to the receiver/beneficiary:

"You have been assigned 10 ECU. You must decide how many of the 10 ECU to transfer to individual B.

In the box, there are red and blue squares, totaling 100 squares. The squares are continuously moving, but the number of squares of each color is constant.

Let p be the portion of blue squares (i.e., the number of blue squares divided by 100). The subject will receive the transferred amount, while you will receive:

- The untransferred amount multiplied by $(1+p)$ if a blue square is drawn;
- The untransferred amount multiplied by p if a red square is drawn.

Decide how much you want to transfer to the other subject (use the . as the decimal separator)."

Dictator Game under Conditions of Risk

As before, considering the treatment condition with lower objective risk, we report an example of the text entered on the decision screen:

Risk to the giver:

"You have a budget of 10 ECU available. You must decide how to distribute the 10 ECU between yourself and another individual who will receive your donation. Decide how much you want to transfer to the other subject (use the . as the decimal separator). The subject will receive:

- *Your donation multiplied by 1.5 with a probability of 0.5;*
- *Your donation multiplied by 0.5 with a probability of 0.5."*

Risk to the receiver/beneficiary:

"You have a total of 10 ECU at your disposal. You must decide how to distribute the 10 ECU between yourself and another individual who will receive your donation. Decide how much you want to transfer to the other individual (use a period as the decimal separator). The other individual will receive the transferred amount, while you will receive:

- *The amount not transferred multiplied by 1.5 with a probability of 0.5;*
- *The amount not transferred multiplied by 0.5 with a probability of 0.5."*

Dictator Game under Conditions of Certainty

Ultimately, we asked subjects to express their social preferences through the standard dictator game:

"You have been assigned 10 ECU. You must decide how many of the 10 ECU to transfer to individual B:

- *Your gain will be equal to 10 ECU minus the transferred amount;*
- *The gain of individual B will be equal to the amount transferred.*

Decide how much you want to transfer to the other subject (use the . as the decimal separator).”

A.2. Allocation Game Settings

Figure A1 presents the results of some simulations used to identify the suitability of the problem set. In this case, the horizontal red line represents the true parameter to be estimated, while the blue line indicates the estimated parameter of the choices made. Following Caferra et al. (2023), estimates are provided for ambiguity aversion (α), risk aversion (ra), level of ambiguity (δ) and the accuracy of choices simulated from a beta distribution (s).

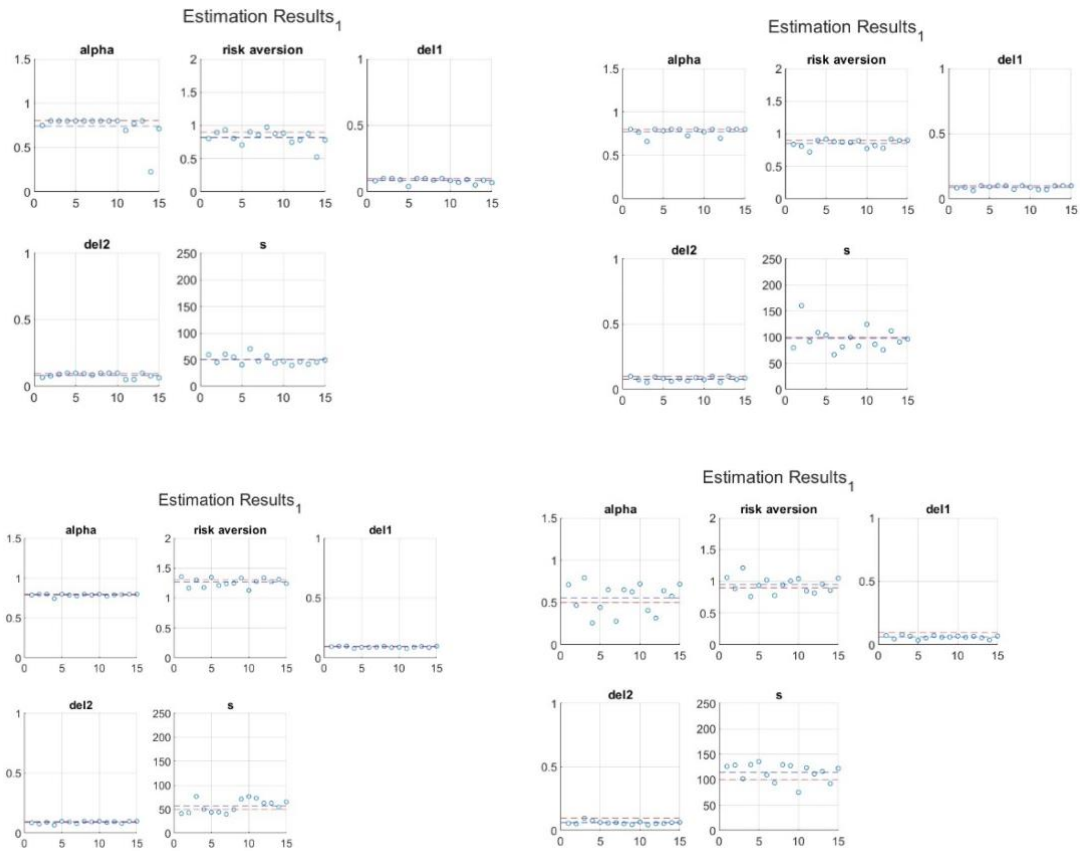


Figure A1. Simulation and estimation results.

The identified problem set (with p indicating the probability of observing the blue outcome in the allocation game) was as follows.

#	p	#	p
1	0.12	21	0.87
2	0.41	22	0.55
3	0.16	23	0.75
4	0.3	24	0.19
5	0.6	25	0.25
6	0.55	26	0.64
7	0.73	27	0.61
8	0.89	28	0.31
9	0.64	29	0.12
10	0.12	30	0.18
11	0.68	31	0.61
12	0.86	32	0.83
13	0.11	33	0.28
14	0.42	34	0.69
15	0.9	35	0.22
16	0.14	36	0.59
17	0.88	37	0.88
18	0.77	38	0.47
19	0.77	39	0.26
20	0.16	40	0.63

Table A1. Problem set used for the allocation game.