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Collective risk taking by couples: individual vs household risk

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Abstract: 101 real couples participated in a controlled experimental risk taking task involving variations in household and individuals' income risks, but controlling for ex-ante income inequality. Our design disentangles the effect of household risk, of intra-household risk inequality and of ex-post pay-off inequality. We find that most couples (about 79%) did pool their risk at the household level when risks were borne symmetrically but a significant proportion of couples (about 36%) failed to do so when individual risks were borne asymmetrically. Furthermore, we find that intra-household risk inequality has a larger impact on non-married couples than married ones.

Keywords: Experiment; Income pooling; Household risk taking; Inequality

JEL Classifications: C91; C92; D19; D81

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1 Introduction

Couples are the main economic decision unit.[1] Perhaps surprisingly, their actual risk-taking behavior remains largely unknown. For simplicity, economists often treat households as a single decision-making unit. Yet, some research has pointed out that preferences of individual household members do not always match and that their beliefs about each other's preferences might be erroneous.[2] In addition, most risk decisions taken by households impact their members unequally, allowing for different preferences even within households.

Consider a typical long-term decision of a household: re-localization to a new city. Such a decision might durably and unequally impact income flows and income risks faced by each member. In particular, this could increase the salary prospect of one member while reducing the salary prospect of another member. In addition to a higher salary, the advantageous household member might boost its human capital, resulting in more satisfaction from work and improved future employability. While some of these advantages can be transferred within a household, some may not, leading to inequalities within the household. It is crucial to study how households behave when faced with such decisions. Not only will this help us better understand how our economy works, but it will also provide a good basis for designing household public policy.

Admittedly, economists have made a lot of progress in modeling household behavior since Becker's (1981) seminal work but empirical evidence remains relatively scarce.[3] Some papers focus on risk attitudes of households in village economies and test their propensity to share risk, using econometrical or experimental methods (Townsend, 1994; Duflo and Udry, 2004; Mazzoco and Shaini, 2012; Chiappori et al., 2014). In some other field studies, the assumption of perfect risk-sharing within couples is specifically tested and rejected (Robinson, 2012). However, to date, only few studies have examined couples' joint risk-taking behavior for prospects that affect individual household members to different degrees .

The methods of experimental economics are of great help to open up the black box of household decision-making processes.[4] Experiments enable control about otherwise unobservable variables and can be used to study couples' joint decisions involving very specific joint prospects. Existing studies have focused on the importance of the balance of bargaining power in the couple regarding risk taking. Braaten and Martinsson (2015) show that the more risk-averse spouse tends to have more influence on decisions; however De Palma et al. (2011) find the opposite, with a balance of power that becomes more and more favorable to women with repetition. Abdellaoui et al. (2013) conclude that bargaining power and individual risk preferences poorly explain risk decisions by

[1] For instance, in 22 over 28 EU countries, households made of a couple are more numerous than single-living individuals; they also constitute two-thirds of households with children (Eurostat, 2018; `https://ec.europa.eu/Eurostat/fr/web/lfs/data/database`). In our study we only consider heterosexual couples living together, either married or not.

[2] Mazzocco (2004) show that about 50% of couples reported that the wife's risk preferences differed from the husband's. In our study, we find that the risk preferences of spouses are not correlated, while Dohmen et al. (2012) find positive correlation of risk-attitudes within couples. The empirical evidence is thus mixed.

[3] See Chiappori (1988), Chiappori and Ekeland (2006), or Vermeulen (2002) for a survey of the recent literature on so-called "collective" household models.

[4] Econometric analysis on real world data requires heavy preference specifications such as separability of preferences across goods or across members. Identification possibilities are defined in Chiappori and Ekeland (2009), whereas Dauphin et al. (2018) provide some kind of critical view.

couples. However, with the exception of Bateman and Munro (2005), payoffs are computed and presented at the level of the couple. They do not analyze the additional trade-off that couples face when risk and payoffs are individual and do not allow to check the existence of perfect risk-sharing.

For risk-free situations, the impact of payoff inequalities within the couple on behavior has already been taken into account in multiple studies (see, e..g., Cochard et al., 2016; Beblo et al., 2015).[5] It appears that intra-household payoff inequality forms a central element for couples' decision-making. It is thus natural to extend the study of various intra-household inequalities, including risk inequalities, to behavior in risky environments.

In this paper we create an innovative experimental design to fill this gap. In a controlled experiment, we present couples with a sequence of binary choices between prospects that vary household risk, intra-household risk inequality (and ex-post payoff inequality). Choices are made jointly by the two partners of the couple. In addition to collecting sociodemographic information on the household, we elicit individual risk preferences as controls (2002). Our design allows us to disentangle the effect of different elements on household risk taking. Based on a sample of 101 French couples, we find that most couples do pool their risk at the household level but a significant fraction fails to do so. We observe that intra-household risk inequality has a larger impact on non-married couples.

The remainder of this paper is organized as follows. Section 2 describes the household risk task and our predictions. Section 3 discusses the experimental methods and details the procedures. Experimental results are reported and discussed in Section 4. We further discuss and conclude in Section 5.

2 Task and predictions

To study joint household risk-taking, we developed a new household risk task. In this task, couples face a series of decision problems between two options. One of the options (option A) is characterized by risk on the household level and no inequality in payoffs. It stays the same throughout all but the last decision situation. The alternative option (option B) is safer on the household level, presents some inequality in individual payoffs, and is altered across the decision situations. In addition to this task, participants responded to a general measure concerning risk aversion on the individual level (Holt and Laury, 2002). In the following, we will outline the household risk task and discuss basic behavioral predictions.

2.1 Household risk task

The household risk task consists of two options, a "risky" option A and a "safe" option B. Both options consist of specific payoffs for the man and the woman and associated probabilities. There are only two possible states of the world in our setting, which happen with one-half probability. Notice that only spouses' individual payoffs are provided in this task and each spouse will only

[5] The literature on laboratory experiments with real couples is emerging. Munro (2018) provides a promising way of revealing and testing the appropriateness of theoretical specifications that could apply to them.

Figure 1 Symmetric decision situations in the household risk task

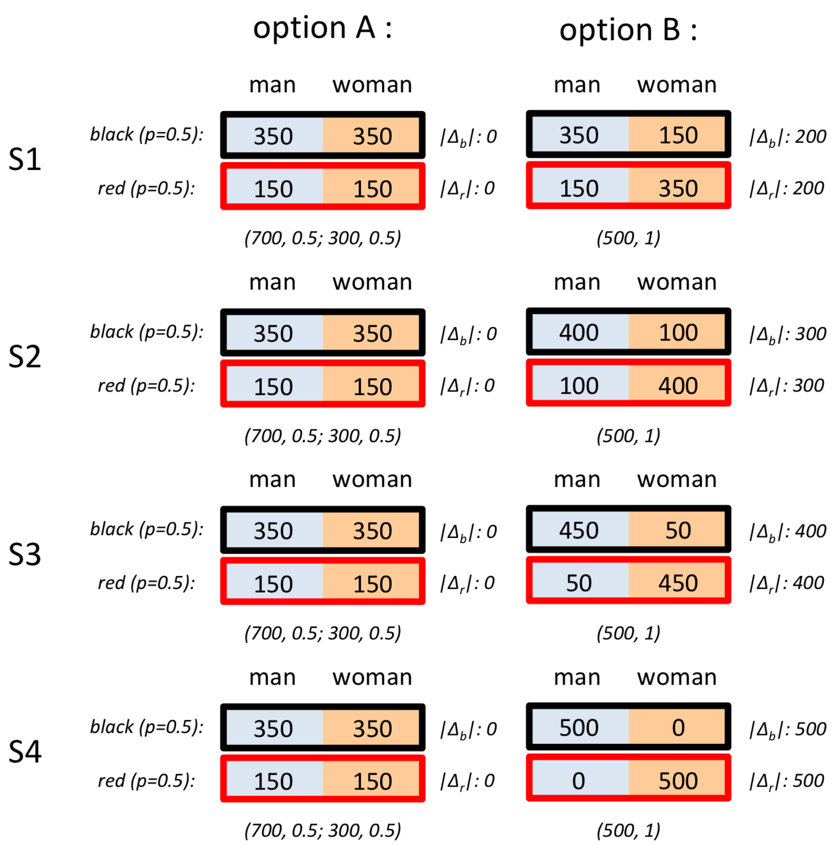


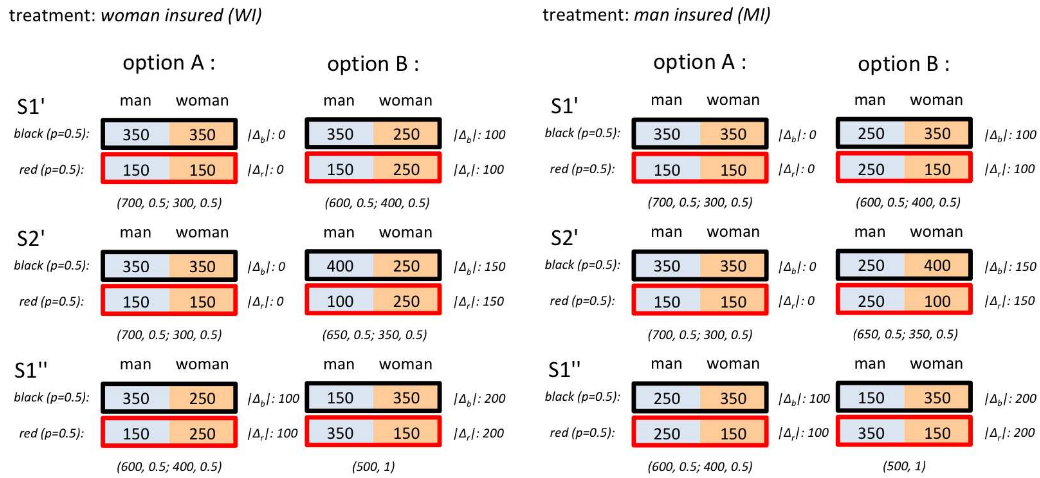
Figure notes: from S1 to S4, inequality in spouses' payoffs is gradually increased in option B. Colored boxes display individual payoffs. The aggregate lottery on the household level is presented in parenthesis.

receive his or her own payoff in the end. However, the joint household payoff for a given state can be easily calculated by summing up both spouses' payoffs.

We will consider two treatment variations as discussed below. Across treatments, couples faced the same first four decision situations. Only the last three decision situations differed across treatments. Figure 1 summarizes the first four situations (i.e., $S1$, $S2$, $S3$, and $S4$), which are *symmetric* in the sense that in the risky as well as in the safe option, spouses receive the same individual risk payoffs. Note that on the individual level all options share the same expected value of 250.[6] Therefore the expected household payoff is always equal to 500. Option A remains unchanged across the four symmetric decision situations. If option A is chosen, both spouses receive the same payoff independent of the resolution of the risk, i.e. either 150 or 350. Therefore both spouses hold the same individual risk and the absolute difference between spouses payoffs (i.e. $|\Delta|$) is zero for both states of the world. Since individual risk payoffs in option A can be represented by a binary lottery $(350, 0.5; 150, 0.5)$, the household risk payoffs are given by $(700, 0.5; 300, 0.5)$. The alternative option (option B) gradually increases (from $S1$ to $S4$) the individual risk exposure of both spouses and the absolute difference between individual payoffs from situation one to four. Due to the symmetry in payoffs, the realized state of the world simply determines whether the man or the women receives the higher payoff, leaving the absolute difference in payoffs ($|\Delta_b|$ and

[6] Earnings from the experiment are calculated in an experimental currency *FT* or *Franc Toulousain* that were exchanged to euros after the session with 50 $FT = 1$ €.

Figure 2 Asymmetric decision situations in the household risk task by treatment



$|\Delta_r|$) equal. Because of this negative correlation of individual payoffs in option B, the option is risk-free on a household level (i.e. $(500, 1)$).

The last three decision situations are *asymmetric* (see Figure 2). Depending on treatment, either men (MI) or women (WI) received some insurance in these situations. For this, we altered situations $S1$ and $S2$ such that the insured player faces no individual risk in option B, while payoffs from option A are unchanged. This change implies that individual risk for the insured player in option B is reduced, however, that household risk of option B is increased. Nevertheless, note that option B is still on a household level less risky than option A.

The last situation ($S1''$) is a variant of the first decision situation ($S1$) where individual insurance is now associated with option A. Thus the insured player's risk is reduced in option A, which reduces household risk but increases inequality between spouses. Again, however, option A is still on a household level riskier than option B and results in lower inequality between spouses.

2.2 Predictions

To interpret our experimental results, we propose a model that embeds several motives. We expect that behavior by households with respect to risk will be influenced by (1) the overall risk to the household, (2) individual risk exposure of each household member and (3) inequality with respect to households members risk exposure.

These three objectives imply that a households objective function should be characterized by risk preferences on the household level, individual risk preferences and an additional term accounting for differences in individual risk exposure.[7]

[7] This model could of course be extended in various ways. It is the simplest way to summarize the behavioral motives that we want to explore in our design. Note also that the function V does not necessarily represent household welfare. It is simply the function that summarizes the relationship between individual preferences and household choices.

$$V(\mathbf{p}) = E^{\mathbf{p}}\big(\lambda^H u^H(x^W + x^M) + \lambda^W u^W(x^W) + \lambda^M u^M(x^M)\big) - \lambda^{ante}|E^{\mathbf{p}} u^W(x^W) - E^{\mathbf{p}} u^M(x^M)| \quad (3)$$

The woman and man within a household are indexed by $i = W,\ M$. The allocation of payoffs between spouses is $x = (x^W,\ x^M)$, with the set of allocations being X. The set of all possible states of the world is denoted as S. A household allocation prospect $\mathbf{p}$ is a function from S into X that assigns to each state $s \in S$ a consequence $\mathbf{p}(s) = x$ in X. In the above specification, all the parameters λ^H, λ^W, λ^M, and λ^{ante} are non-negative. The first three terms $u^H(x^W + x^M)$, $u^W(x^W)$ and $u^M(x^M)$ represent utility from joint household payoff, the individual payoff of the woman and the man, respectively. The last term represents household disutility due to inequality in terms of ex-ante risk allocations.

Our experiment was designed so as to hold the expected value of individual payoffs constant across tasks and treatments. By introducing a negative correlation of individual payoffs, we are further able to alter individual risk exposure while holding household risk at the same level.[8] Let us now discuss the interpretations of this model for three reference situations.

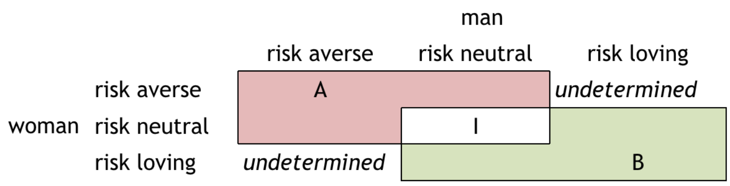
The simplest case (which we denote **case I: Income-pooling**) occurs when the household only focuses on the sum of both spouses' incomes $x^W + x^M$ and its associated risk. In this case individual risk and the inequality in individual risk exposure should not influence the households behavior. In the terms of our model above, this implies that λ^M, λ^W, and λ^{ante} equal to zero. In this situation, we may also assume that the household acts like an agent with vNM expected utility and will thereby solely focus on the joint household payoff.[9] In the household risk task, both options give the same expected returns on the household level, and option A is always riskier than option B on a household level (see Figures 1 and 2). So a consistent couple should choose the same option across all the decision situations. Specifically, a risk-averse couple should choose always option B, a risk-neutral couple always indifference (I), and a risk-loving couple option A. Note that predictions are independent of treatment.

Alternatively we can imagine that only individual income and risk is relevant to spouses and that household returns and inequality do not matter (i.e. λ^H and λ^{post} equal to zero). This case (**case II: Bargaining**) implies that the objective function of the household coincides with a convex combination of each member's sub-utility, which is the usual specification in collective household models. Thus $\lambda^M + \lambda^W = 1$ and λ^M, $\lambda^W \in [0, 1]$. These parameters can be interpreted as a measure of male or female bargaining power within a household. The bargaining power parameter might

[8] For ease of presentation and testing, we chose to keep the model simple. We could also consider asymmetries in the inequality aversion parameter (i.e., λ^{ante}). However, previous work has shown that inequality aversion is highly symmetric for a similar subject pool in France. As we shall see, we do not find any significant treatment effect, meaning that couples are equally averse to risk inequality regardless of its direction. It is also theoretically possible to introduce ex-post inequality aversion, which would depend on intra-household ex-post payoff allocations (i.e., $\lambda^{post} E^{\mathbf{p}}|u(x^W) - u(x^M)|$ with $\lambda^{post} \geq 0$). However, we think this dimension of trade-off is irrelevant in household decision making in our setting. The reason is because couples completed several tasks in which they could earn money and they were only informed of how much their total earning was at the end of the experiment. Moreover, personal earning was private information in our study. Without partners' precise payoff information in the household risk task, social comparison is impossible. In an early version of this paper, we conducted tests on ex-post inequality aversion and rejected it.

[9] Notice that this assumption is not required for interpreting our results. For instance, we could also allow for probability weighting in household preferences (e.g., Abdellaoui et al., 2013).

Figure 3 Predictions in case of bargaining for situations S2, S3 and S4



reflect better outside options of the individual or that the household chooses to put more weight on a specific household member (e.g. altruism). The traditional male bread-winner situation is covered with λ^W equals to zero.

In this case our predictions depend on individual risk attitudes. In total, we can classify households into nine (i.e. 3×3) different categories. Figure 3 summarizes the predictions regarding household decisions for the symmetric decision situations.[10] Note that predictions are the same for situations S2, S3 and S4. Couples with two risk-averse spouses or one risk-neutral spouse and one risk-averse spouse should choose option A, which is safer than option B in individual risks (see Figure 1). Couples with two risk-loving spouses or one risk-neutral spouse and one risk-loving spouse should choose option B. In the asymmetric decision situations, predictions depend on the decision weights and the difference between the risk preferences of spouses (see Table A.1 in Appendix). When both spouses have the same risk preferences, the predictions are independent of treatment. We predict a switch between treatments WI and MI for couples that do not have the same risk preferences.

In the last case (**case III**: **risk-inequality aversion**), the household only focuses on intra-household risk inequality, without considering household or individual risks (i.e. λ^H, λ^W and λ^M equal to zero).[11] A purely inequality averse household seeks to minimize $|E^{\mathbf{P}}u^W(x^W) - E^{\mathbf{P}}u^M(x^M)|$. In the symmetric decision situations where spouses bear the same risk, couples should be indifferent between option A and option B. But option A generates less risk inequality than option B in decision situation $S1'$ and $S2'$, but the opposite is true in decision situation $S1''$. It is worth noting that risk inequality is the largest in decision situation $S2'$.

Most likely, all elements will play a role in behavior. Decision situations $S1$ to $S4$ will enable us to see whether households will choose the safe option on the household level, if individual risk for spouses is increased but in the absence of any risk inequality. Situations $S1'$, $S2'$ and $S1''$ introduce risk inequality between spouses while keeping household risk relatively low in the safe option.

[10] Note that in decision situation $S1$, both spouses face the same individual payoffs whatever option is chosen (see Figure 1), so model II predicts indifference independent of the individual risk preferences.

[11] Recent literature shows that risk preference and social preference should be combined to explain some experimental observations, see Cettolin et al. (2017). As we shall see, our experimental results show that this is even true within couples.

3 Experimental methods

Our experiment consists of two phases with two types of tasks: an individual risk and a household risk task. Participants first completed the individual risk task. This task allows us to control for individual risk attitudes in the household risk task. Participants responded to the individual risk task on their own. Participants responded jointly with their partner in the household risk task. Couples were randomly assigned into one of two treatments, *woman insured* (WI) versus *man insured* (MI). In the following subsections, we describe each task and provide details on experimental procedures.

3.1 Experimental procedures

The experiment was conducted in 2010 at the Toulouse School of Economics, France. Participants were recruited by newspaper reports announcing the ongoing study, flyers, and information provided on a website. The recruitment information specified that heterosexual couples between 25 and 65 years old were invited to participate in a two-hour study of economic decisions in couples. Couples were required to have been living together for at least one year, but did not need to be married.[12] The announcements further specified that each participant would earn, dependent on their decisions, an amount between 20 and 60 €.[13]

Couples were seated in six rows of tables in the laboratory, one couple per row. During the individual risk task, partitions were placed such that participants were aware that their partners were seated on the other side of the partition. However, they were unable to see or communicate with them. During the household risk task, spouses were seated next to each other at a table. Spouses were allowed to communicate during this task without a time limit.

The experiment was conducted by paper and pencil. Considerable care was taken to explain the instructions as simple as possible, and decision sheets were presented in a graphically intuitive way. Computers were avoided due to the large variance in the age and educational backgrounds of our participants. Instructions for each part were read aloud and explained with the aid of a video projection of the decision sheets. Participants were actively encouraged to ask questions if something was unclear. After instructions were read, a summary of the instructions was distributed and participants were required to answer a short control question to test their comprehension. When participants had finished reading the summary, and correctly answered the control question, they were invited to mark their decisions on the decision sheets.

When all couples had completed the experiment, a volunteer among the participants was chosen to supervise the randomization procedure to decide which decisions would be paid out. This required the participant tossing a die and picking a random number from a box of numbered tickets. This then led to the calculation of gains and earnings. Participants were asked to respond to a final anonymous individual questionnaire, which included standard socio-demographic questions.

[12] A number of control questions that were part of the demographic questionnaire were used to verify whether or not participants were in a genuine relationship.

[13] The experiment included several other experimental parts concerning cooperation, efficiency, and equality as discussed in Cochard et al. (2016). The joint risk part discussed in this paper was not discussed in earlier work.

Participants were paid individually in a separate room.

3.2 Household risk task

During this part of the experiment, spouses were asked to join their partner at a table to make their decisions jointly. Spouses could discuss freely until reaching a common agreement. Couples were presented with the seven decision situations of the household risk task described above (for an example see Appendix A). For each situation they had to make a choice between the "safe" option A and the "risky" option B. In case of being indifferent, they could choose option I. In this case, either option A or option B was selected with one-half probability. Spouses were paid their individual payoffs from this task. We took great care in explaining that each participant would only learn about his or her own earning in the end. Thus even though we cannot exclude the possibility that spouses agreed to share the payoffs after the experiment, this provided participants the opportunity to conceal their true earnings from their spouse.

All couples were randomly assigned to one of two treatment groups (MI or WI). Across treatments, couples faced the same first four decision situations. Only the last three decision situations differed as described above. Decisions were presented to all participants in the same order. However, we counterbalanced the presentation (right or left) of the safe and risky option on the decision sheet.

3.3 Individual risk task and sociodemographic questionnaire

During the individual risk task, spouses were seated separately and answered the standard risk attitude elicitation task from Holt and Laury (2002). The instruction of the task and a screenshot of the decisions can be found in Appendix A.[14] Participants made 10 decisions between a "safe" option A and a "risky" option B. Participants could also indicate to be indifferent (I), in this case, either option A or option B was randomly selected with one-half probability.

As participants move down the list of the decisions (see Figure A.1), the difference between the expected values of option B and option A increases gradually. Participants who maximize their expected payoffs should strictly prefer option A for decisions 1 to 4 and option B for decisions 5 to 10.

Assuming vNM expected utility maximization with a power utility function, participants should have at most one switching point. Moreover, they should only switch from option A to option B, or to option I once and then to option B. We will use these criteria to identify participants that make consistent decisions.

This task is useful to quantify individual risk aversion which is required for predicting household decisions. We will use the number of the decision at which a participant switched from option A

[14] The experiment was conducted in French. The original French instructions are available upon request. On the screenshots of our experiment, different icons are used to represent the man and the woman. This was to help participants easily understand for whom their decisions were made and what would be their payoffs if an option was chosen.

to option B.[15] As discussed above, a risk-neutral participant will have a risk aversion level of 4, denoted $RA = 4$. A risk-averse participant will have a $RA > 4$, while a risk-seeking participant will have a $RA < 4$.

The sociodemographic questionnaire was distributed after participants had completed all decision tasks. The questionnaire contained several questions on age, children, marital status, individual and household financial management. Participants answered the questionnaire alone on their table and were provided an envelope to return the questionnaire to the experimenters.

4 Results

In the following, we will first present descriptive statistics concerning individual and household characteristics involving individual risk attitudes (Section 4.1), and then will give the results for the household risk task (Section 4.2).

4.1 Individual and household characteristics

In total, 101 heterosexual couples participated in our study (51 in treatment WI and 50 in treatment MI). A total of 19 sessions were conducted, with at least four and at most six couples present. The mean age of men and women was 35 and 34 years, respectively. Partners had been living together for an average of 7.9 years, with 44% of participating couples married, and 48% with at least one child living in their household (on the individual level 47% of participants had at least one child). Our pool of volunteers shows a reasonable degree of heterogeneity in terms of age and couple characteristics. On average our participants are characterized by rather high rates of employment and good socio-professional status. Couples in treatment WI and MI show a very similar distribution of couple characteristics with no significant difference (see Table A.2 in Appendix B).

Overall, 202 participants made their decisions in the risk task. As discussed previously, a rational vNM expected utility maximizer would switch at most once from option A to option B (or to option I once, then to option B). Only 34 (16.8%) of participants did not fulfill this consistency criterion. In the analysis presented in the next two paragraphs, we will restrict our sample to participants categorized as consistent at an individual level (168 individuals) or the couple level (73 couples). All results are qualitatively robust to these restrictions.

We find a mean Risk Aversion (RA) of 5.23 for men (std. dev = 1.68) and 5.49 for women (std. dev = 1.55), both statistically greater than 4 (Wilcoxon signed-rank test p-values < 0.001).[16] These levels of RA correspond to a range of relative risk aversion between 0.15 and 0.68 in case of a power utility function. Thus both men and women are moderately risk-averse and we observe no significant difference in RA (Wilcoxon signed-rank test p-value = 0.19). We find no correlation

[15] One could also employ the value of parameter r as a measure of risk aversion, with a utility function $u(x) = x^{1-r}/(1-r)$. Then risk preference is represented by a negative r, risk neutrality by a null r, and risk aversion by a positive r. Moreover, a higher r means more risk aversion. Within our setting, one can only deduce a range of values for r given a participant's switching point. So the arithmetic mean of the range could be a good proxy of risk aversion level.

[16] All reported tests are two-sided in this paper. Men in our sample are slightly more risk-averse than usually observed. For instance, He et al. (2012) found a mean RA of 4.48 for men with student couples.

of RA with earnings, having children, marriage status, or education level and a weak correlation with age, which vanishes when controlling for gender and education (Table A.3 in Appendix B).[17]

There is no significant difference in the risk attitudes of spouses (Paired Wilcoxon signed-rank test p-value = 0.32) nor a significant correlation between them ($\rho = 0.12$, p-value = 0.32). Differences in risk attitudes can not be explained by either the years of joint life, marriage status, or having common children (Table A.4 in Appendix B).

Result 1: Men and women are moderately risk-averse. Individual risk attitudes are hardly explained by covariates and are uncorrelated within the couple.

For the remaining analysis, we will consider the full sample while keeping in mind that most spouses are risk averse. This is not only for ease of demonstration but also to gain more statistical power due to our limited sample size. However, the results presented in this paper remain valid if we restrict our analysis to the couples with two spouses who were consistent and risk averse in the individual risk task.[18]

4.2 Household risk-taking

We now discuss our results from the household risk task in light of the general behavioral household model of Section 2.2.

4.2.1 Household risk versus individual risk

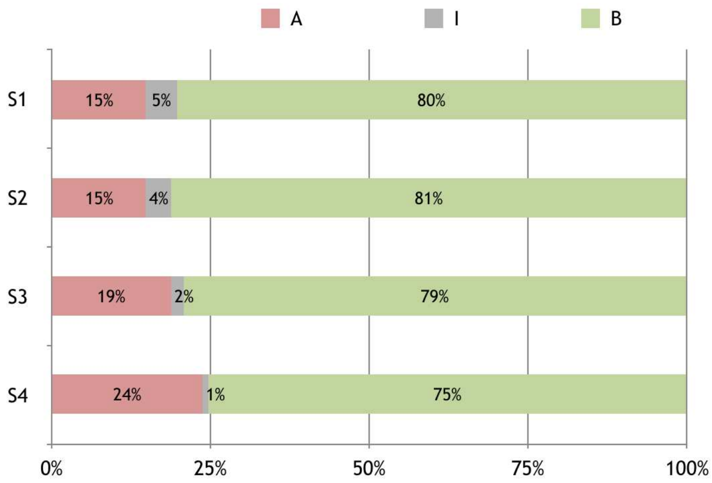
Recall that moving from situation $S1$ to $S4$, we increase the individual risk of both spouses equally and incrementally in option B and keep household risk constant in both options. Moreover, within each option there is no risk inequality between spouses (see Figure 1). Across all the symmetric decision situations more than 79% of couples choose option B (see Figures 4 and Table A.5 in Appendix B). Since we observe a large majority of couples choosing option B, we conclude that households prioritize the reduction of household risk over a reduction of individual risk. We can clearly reject the hypothesis that households put a zero weight on household risk for the symmetric decision situations (t-test p-value < 0.001). When the dilemma concerning the higher individual risk implied by option B becomes stronger ($S1$ versus $S4$), we only see a slight increase in the number of couples choosing option A from 15 to 24 (McNemar's Chi-squared test p-value = 0.06).

Result 2: In the symmetric situations, approximately 79% of the couples prefer a reduction of risk at the household level over a reduction of risk at the individual level.

[17] PACS is a contractual form of civil union between two adults. Education is measured by years of study. See Dohmen et al. (2011), and Hartog et al. (2002) for similar studies.

[18] For consistent couples, we can consider the combinations between risk-averse, risk-neutral, and risk-seeking men and women. There are thus a total of nine (3×3) possible combinations of individual risk preferences. The majority: 43 out of 73 couples (59%) have two risk-averse spouses. The distribution of couples across the different combinations of risk preferences does not differ significantly between the two treatment groups (Chi-2 test p-value = 0.13). We also find no difference concerning RA between participants in treatment WI and MI for either gender.

Figure 4 Histogram of decisions by all couples in the symmetric decision situations

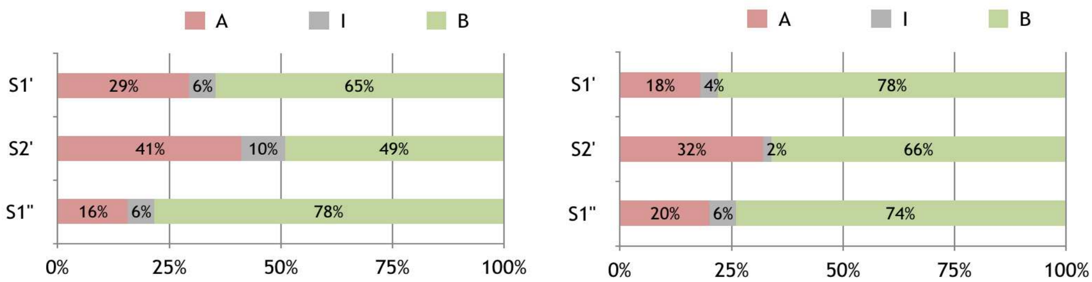


4.2.2 Aversion to risk inequality and treatment comparison

Figure 5 shows aggregate choices by couples in the three asymmetric decision situations. Remember that women in treatment WI (and men in treatment MI) received a reduction of individual risk in option B in situations $S1'$ and $S2'$ and in option A in situation $S1''$ (see Figure 2). In whatever treatment, we observe that the proportion of couples choosing option B decline in the asymmetric decision situations compared to that in the symmetric decision situations. This decline appears to be more relevant in situation $S2'$ where risk inequality between spouses is the largest.

Besides the importance of income pooling, we now analyze the importance of concerns for risk inequality. To do so, we compare couples' behaviors in situations $S1$ and $S1'$, and their behaviors in situations $S2$ and $S2'$. Note that one spouse always bears less risk and household risk remains smaller in option B comparing these two asymmetric situations with their symmetric counterparts. If risk inequality does matter in household risk taking, we should expect less couples to choose option B. This is indeed what we observe. Comparing the decision situations with the greatest risk inequality, $S2$ and $S2''$, we find the number of couples choosing option B reduces significantly from

Figure 5 Histogram of decisions by all couples in the asymmetric decision situations



(a) treatment WI **(b)** treatment MI

Figure notes: there were 51 couples in treatment WI and 50 couples in treatment MI.

Table 1 Distribution of couples' choices in situations $S1'$ and $S1''$ by marriage status

(a) Situation $S1'$

	married	PACS	Just couple
A	7	6	11
I	1	2	2
B	36	3	33
Total	44	11	46

(b) Situation $S1''$

	married	PACS	Just couple
A	10	5	22
I	4	0	2
B	30	6	22
Total	44	11	46

82 couples to 58 (McNemar's Chi-squared test p-value < 0.001). The difference between situations $S1$ and $S1'$ is not significant (81 versus 72, McNemar's Chi-squared test p-value $= 0.19$). This may be because risk inequality in situation $S1'$ was not large enough to induce any significant household behavior change. Neither is there any significant difference between situations $S1$ and $S1''$ (82 versus 77, McNemar's Chi-squared test p-value $= 0.38$). Note that risk inequality is larger in option A of situation $S1''$ but men or women also bear less risk. So these two effects just cancel each other out.

Though couples' behavior seems to vary a bit between treatments, especially in situation $S2'$, we do not find any treatment effect on whether men or women bear more risk. In Table A.6 in Appendix B, we run logistic regressions to compare couples' choices in the asymmetric situations ($S1'$, $S2'$ and $S1''$) and in the symmetric ones ($S1'$ and $S2'$), while controlling for possible treatment effect. As this shows in both asymmetric situations $S1'$ and $S2'$, couples are significantly less likely to choose option B compared to their symmetric counterparts due to risk inequality concern. However, this aversion to risk inequality is independent of whether men or women hold more risk, as shown by the insignificant coefficient estimates of the interaction terms. We summarize our results below.

Result 3: Comparing the asymmetric decision situations with their symmetric counterparts, we observe that couples are significantly less likely to pool their risk due to risk inequality concern. We also do not find any treatment effect on whether men or women hold more or less risk.

4.2.3 The effect of marriage status

To answer the question which households achieve high level of risk pooling, we consider results from logistic regressions. We find that married couples have a significantly higher probability of choosing option B, which is safer at the household level, compared to couples with other types of relationships (see Table A.7 in Appendix B). Interestingly, other household characteristics, like the number of years living together, having jointly children, having a joint bank account, etc., which correlate significantly with the marriage status, have no explanatory power on household risk decisions. It appears indeed that about 82% of married couples choose option B in situation $S1'$, whereas only 63% of non-married couples do so (see Table 1). A similar difference is also observed in situation $S1''$ (68% for married couples versus 49% for non-married ones). This could be due to the higher intrinsic commitment of these couples (better communication and trust) or improved enforcement mechanisms (through family norms or marriage contract).

Given the positive effect of marriage status, we want to ask a further question: are married couples less averse to risk inequality? To answer this question, we look at how married and non-married couples react to the introduction of risk inequality. We define two variables on household switching behavior from $S1$ to $S1'$ and from $S2$ to $S2'$. These two variables equal to 0 if no switching occurs, or couples switch from the indifference option to option A or B or the other way round, and equal to -1 if couples switch from option B to option A, and 1 otherwise (see Table A.8 in Appendix B). Overall, we find that married couples seem less likely to switch from option B to A (see the pooled results in column (3) of Table A.8), namely, they are less averse to risk inequality.

Result 4: Married couples are significantly more likely to pool their risk in the household risk task even in face of high risk inequality.

5 Conclusion

Our study presented results from a novel type of experimental dilemma where individual risk attitudes interact with household risk sharing. It provides two major contributions. On the one hand, it extends research on resource allocation dilemmas within households to risk contexts. Second, it adds to the literature on informal insurance and risk-sharing for couples from western European countries.

Studies on risk-taking by households have predominantly focused on risk at the household level under the assumption that the final allocation of resources across household members will be influenced by a bargaining process that can be studied separately. While this approach makes sense for risk situations involving monetary returns, it does not make sense for situations where returns and risks are at the individual level. Decisions concerning health or labor market risks are likely to have consequences for individuals that cannot be easily equalized by side payments. When choosing a living location, accepting a job, or even choosing between a joint and an individual taxation system, individual earning patterns and its volatility could be affected in various ways. Intra-household income and risk inequalities are also impacted and this could matter for household decision-making. We, therefore, focus on joint choices concerning individual lotteries, which is different from what is usually presented in the literature. Since incomes are individual, whereas choices are joint, these situations reflect situations that couples may face in reality.

Perfect risk-sharing, i.e., prioritizing a reduction of the household's income volatility, appears as the dominant attitude. We observed that about 80% of couples did pool their risk at the household level when risks were borne symmetrically. However, when put into extreme risk inequality situations, only 57% of couples continued to adopt this scheme. That is, a non negligible share of couples abandoned perfect risk-sharing due to risk inequality. Experimental evidence further shows that intra-household inequality had a larger impact on household decision-making for non-married couples. This surely reflects the impossibility for these couples to agree and commit to an appropriate sharing rule. Since our participants were allowed to freely communicate when taking a joint decision, it could be because of norms or some kind of rigidity in the usual sharing-rule agreement of these couples. Overall, our results confirm that considering the household as a unique decision maker regarding risk-taking would generate errors, especially when household choices involve idiosyncratic individual shocks.

Compliance with ethical standards

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References

Abdellaoui, M., O. l'Haridon, and C. Paraschiv (2013). Individual vs. couple behavior: an experimental investigation of risk preferences. *Theory and Decision 75*(2), 1–17.

Agler, I. and J. W. Weibull (2010). Kinship, incentives, and evolution. *American Economic Review 100*(4), 1725–1758.

Bateman, I. and A. Munro (2005). An experiment on risky choice amongst households. *Economic Journal 115*(502), 176–189.

Beblo, M., D. Beninger, F. Cochard, H. Couprie, and A. Hopfensitz (2015). Efficiency-equality trade-off within french and german couples: a comparative experimental study. *Annals of Economics and Statistics 0*(117-118), 233–252.

Becker, G. S. (1981). Altruism in the family and selfishness in the market place. *Economica 48*(189), 1–15.

Bolton, G. E. and A. Ockenfels (2000). Erc: a theory of equity, reciprocity, and competition. *American Economic Review 90*(1), 166–193.

Braaten, R. H. and P. Martinsson (2015). Experimental measures of household decision power. Technical report, Technical Report 02/2015 CREE.

Brock, J. M., A. Lange, and E. Y. Ozbay (2013). Dictating the risk: experimental evidence on giving in risky environments. *American Economic Review 103*(1), 415–437.

Cettolin, E., A. Riedl, and G. Tran (2017). Giving in the face of risk. *Journal of Risk and Uncertainty 55*(2-3), 95–118.

Charness, G. and M. Rabin (2002). Understanding social preferences with simple tests. *Quarterly Journal of Economics 117*(3), 817–869.

Chiappori, P.-A. (1988). Rational household labor supply. *Econometrica 56*(1), 63–89.

Chiappori, P.-A. and I. Ekeland (2006). The micro economics of group behavior: General characterization. *Journal of Economic Theory 130*, 1–26.

Chiappori, P.-A. and I. Ekeland (2009). The micro economics of group behavior: Identification. *Econometrica 77*(3), 763–799.

Chiappori, P.-A., K. Samphantharak, S. Schulhofer-Wohl, and R. M. Townsend (2014). Heterogeneity and risk sharing in village economies. *Quantitative economics 5*(1), 1–27.

Cochard, F., H. Couprie, and A. Hopfensitz (2016). Do spouses cooperate? an experimental investigation. *Review of Economics of the Household 14*(1), 1–26.

Cochrane, J. H. (1991). A simple test of consumption insurance. *Journal of Political Economy 99*(5), 957–976.

Couprie, H., E. Cudeville, and C. Sofer (2020). Efficiency versus gender roles and stereotypes: an experiment in domestic production. *Experimental Economics 23*(1), 181–211.

Cox, D. and M. Fafchamps (2007). Extended family and kinship networks: economic insights and evolutionary directions. *Handbook of Development Economics 4*, 3711–3784.

Dauphin, A., B. Fortin, and G. Lacroix (2018). Is consumption efficiency within households falsifiable? *Review of Economics of the Household 16*(3), 737–766.

De Palma, A., N. Picard, and A. Ziegelmeyer (2011). Individual and couple decision behavior under risk: evidence on the dynamics of power balance. *Theory and Decision 70*(1), 45–64.

Dohmen, T., A. Falk, D. Huffman, and U. Sunde (2012). The intergenerational transmission of risk and trust attitudes. *Review of Economic Studies 79*(2), 645–677.

Dohmen, T., A. Falk, D. Huffman, U. Sunde, J. Schupp, and G. G. Wagner (2011). Individual risk attitudes: measurement, determinants, and behavioral consequences. *Journal of the European Economic Association 9*(3), 522–550.

Duflo, E. and C. Udry (2004). Intrahousehold resource allocation in cote d'ivoire: social norms, separate accounts and consumption choices. Technical report, National Bureau of Economic Research.

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

Fudenberg, D. and D. K. Levine (2012). Fairness, risk preferences and independence: impossibility theorems. *Journal of Economic Behavior & Organization 81*(2), 606–612.

Gollier, C. (2001). *The economics of risk and time.* MIT Press.

Hartog, J., A. Ferrer-i Carbonell, and N. Jonker (2002). Linking measured risk aversion to individual characteristics. *Kyklos 55*(1), 3–26.

He, H., P. Martinsson, and M. Sutter (2012). Group decision making under risk: an experiment with student couples. *Economics Letters 117*(3), 691–693.

Holt, C. A. and S. Laury (2002). Risk aversion and incentive effects. *American Economic Review 92*(5), 1644–1655.

Krawczyk, M. and F. Le Lec (2016). Dictating the risk: experimental evidence on giving in risky environments: comment. *American Economic Review 106*(3), 836–839.

Mazzocco, M. (2004). Saving, risk sharing, and preferences for risk. *American Economic Review 94*(4), 1169–1182.

Mazzocco, M. and S. Saini (2012). Testing efficient risk sharing with heterogeneous risk preferences. *American Economic Review 102*(1), 428–468.

Munro, A. (2018). Intra-household experiments: a survey. *Journal of Economic Surveys 32*(1), 134–175.

Robinson, J. (2012). Limited insurance within the household: evidence from a field experiment in kenya. *American Economic Journal: Applied Economics 4*(4), 140–164.

Saito, K. (2013). Social preferences under risk: equality of opportunity versus equality of outcome. *American Economic Review 103*(7), 3084–3101.

Townsend, R. M. (1994). Risk and insurance in village india. *Econometrica 62*(3), 539–591.

Udry, C. (1996). Gender, agricultural production, and the theory of the household. *Journal of Political Economy 104*(5), 1010–1046.

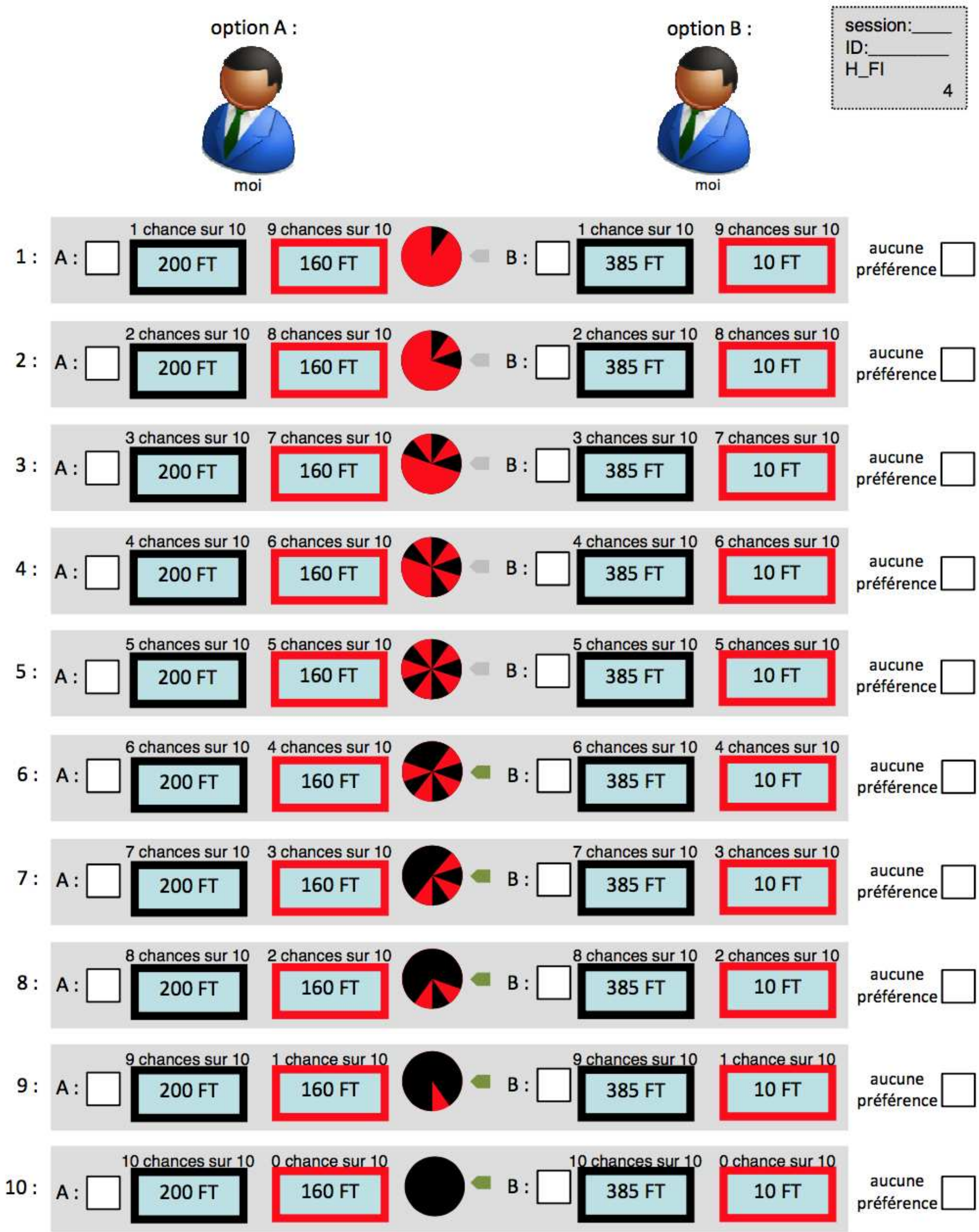
Vermeulen, F. (2002). Collective household models: principles and main results. *Journal of Economic Surveys 16*(4), 533–564.

Appendix A: Instructions and screenshots

Individual risk task

During this part of the experiment, you will be invited to make a series of choices. Your earning in this part will depend only on your own decisions. We're going to distribute to you a sheet of paper on which you will have to make ten decisions, numbered from 1 to 10. Each decision is a paired choice between "option A" and "option B". For each decision row you will have to choose between option A and option B, or indicate being indifferent between the two. You may choose

Figure A.1 Individual risk task (Holt and Laury, 2002)



option A for some decision rows and option B for other rows, and you may change your decisions and make them in any order. For each decision row, a roulette in red and black will be played to determine the payoff of your chosen option.

Take the second decision row as example. As you can see, there is two in ten chance that the ball of the roulette stops in some black zone and eight in ten chance that the ball stops in some red zone. Payoff of each option is framed in the color of the zone where the ball stops and the probability of the payoff is also given on top of it. For instance, when you have chosen the option A, if the ball stops in a black zone you will earn 200 FT and otherwise 160 FT; when you have chosen the option B, if the ball stops in a black zone you will earn 385 FT and otherwise 10 FT.

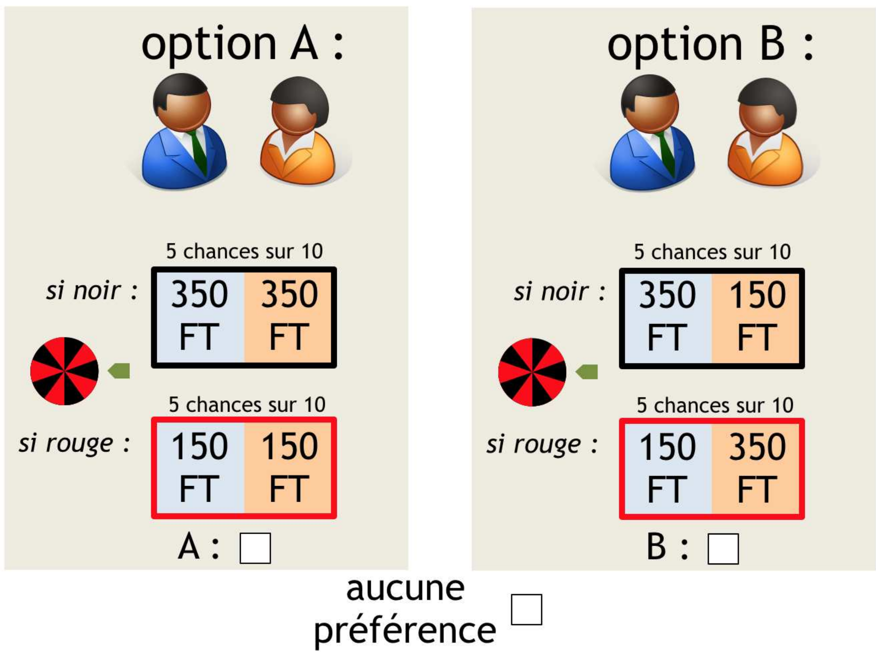
Even though you will make ten decisions, only one of them will be randomly selected by throwing a ten-sided die, whose faces are numbered from 1 to 10 and end up affecting your earning. You will not know in advance which decision will be used. All decisions have equal chance of being relevant for your payoffs. In case that you were indifferent between the two options in the selected row, a coin is tossed to decide which option will be relevant for your earning.

Household risk task

(For those who have another chair beside you, please stay in your place and we will let your partner come to join you). During this part of the experiment, you and your partner will have to make jointly a series of decisions. So please feel free to discuss with your partner and make your joint decision once you decided.

Now we are going to distribute you a sheet of paper on which you will encounter seven decision situations. In each situation, you need to make a choice between option A and B, or indicate being indifferent between the two. A roulette in red and black will be played to determine your payoff

Figure A.2 Illustration of household risk task presentation: decision situation $S1$



and your partner's in your chosen option. The payoffs are framed in the color of the zone where the ball of the roulette stops. The probability of payoffs are given on top of them.

Take the decision situation 1 as example. In option A, there is five in ten chance that the ball of the roulette stops in some black zone and another five in ten chance that the ball stops in some red zone. Both you and your partner will earn 350 FT if the ball stops in a black zone and 150 FT, otherwise. In option B, there will be also five in ten chance that the ball of the roulette stops in some black zone and another five in ten chance that the ball stops in some red zone. In case that the ball stops in a black zone, man will earn 350 FT and woman 150 FT. Otherwise, man will earn 150 FT and woman 350 FT. For the other decision situations, the principle remains the same and only payoffs differ.

Although this part of the experiment constitutes of several decision situations, only one of them will be randomly selected by drawing from a box with tickets numbered from 1 to 7 and end up affecting your earning. Since all situations have equal chance of being chosen, so they are equally important for your payoff. If in the selected decision situation you were indifferent between two options, a coin is tossed to decide which option will be relevant for your payoff.

Appendix B: Additional results

Table A.1 Predictions in case of bargaining for situations $S1'$, $S2'$ and $S1''$

		man		
		averse	neutral	loving
woman	averse	$(B\ ?\ A)$	(**B B A**)	(**B B A**)
	neutral	(**I A I**)	$(I\ I\ I)$	(**I B I**)
	loving	(**A A B**)	(**A A B**)	$(A\ ?\ B)$

(a) treatment WI

		man		
		averse	neutral	loving
woman	averse	$(B\ ?\ A)$	(**I A I**)	(**A A B**)
	neutral	(**B B A**)	$(I\ I\ I)$	(**A A B**)
	loving	(**B B A**)	(**I B I**)	$(A\ ?\ B)$

(b) treatment MI

Table notes: ? means undetermined. When $\lambda^M = 0$ and $\lambda^W = 1$, the predictions are the same as when the man is risk neutral (i.e. the second column in Figure 3). Similarly, when $\lambda^M = 1$ and $\lambda^W = 0$, the predictions correspond to the second row in Figure 3.

Table A.2 Descriptive statistics of couple characteristics

Variable	treatment WI	treatment MI	all couples	p-value
common children (dummy)	35%	44%	40%	0.38
years living together	7.85	7.84	7.85	0.86
civil union (PACS)	12%	10%	11%	0.78
married	45%	42%	43.5%	0.76

Table notes: there are in total 51 couples in treatment WI and 50 couples in treatment MI. The last column reports the Wilcoxon signed-rank test p-values for treatment comparisons.

Table A.3 Simple linear regressions with risk aversion level (RA) as dependent variable

Variable	(1)	(2)	(3)	(4)
woman	1.21	0.18	-0.13	0.57
	(1.00)	(0.33)	(0.75)	(0.37)
age	-0.01			
	(0.02)			
age × woman	-0.03			
	(0.03)			
children		-0.35		
		(0.35)		
children × woman		0.21		
		(0.51)		
earning			-0.09	
			(0.11)	
earning × woman			0.08	
			(0.16)	
PACS				-0.23
				(0.57)
married				0.30
				(0.37)
PACS × woman				0.23
				(0.83)
married × woman				−0.77
				(0.53)
education	0.03	0.03	0.03	0.02
	(0.04)	(0.04)	(0.04)	(0.04)
Intercept	5.04^{***}	4.82^{***}	5.23^{***}	4.73^{***}
	(0.91)	(0.68)	(0.90)	(0.70)

Table notes: only 168 consistent participants are considered here. Numbers in parenthesis are standard errors. Statistical significance is indicated as follows: *p<0.1; **p<0.05; ***p<0.01.

Table A.4 A linear regression of the absolute difference in the risk aversion level of two spouses

Variable	Coefficient (Std.Err.)
PACS	−0.05
	(0.53)
married	0.29
	(0.44)
years living together	−0.001
	(0.05)
number of common children	0.22
	(0.33)
Intercept	1.32***
	(0.26)

Table notes: the absolute difference in the risk aversion level is measured by $\mid RA^W - RA^M \mid$. There were in total 73 consistent couples. Statistical significance is indicated as follows: *p<0.1; **p<0.05; ***p<0.01.

Table A.5 Overview of decisions made in two treatments by all couples

	treatment WI (51 couples)			treatment MI (50 couples)		
situation	option B	option I	option A	option B	option I	option A
$S1$	41 (80.39%)	4 (7.84%)	6 (11.76%)	40 (80%)	1 (2%)	9 (18%)
$S2$	41 (80.39%)	2 (3.92%)	8 (15.69%)	41 (82%)	2 (4%)	7 (14%)
$S3$	40 (78.43%)	2 (3.92%)	9 (17.65%)	40 (80%)	0 (0%)	10 (20%)
$S4$	37 (72.55%)	1 (1.96%)	13 (25.49%)	39 (78%)	0 (0%)	11 (22%)
$S1'$	33 (64.71%)	3 (5.88%)	15 (29.41%)	39 (78%)	2 (4%)	9 (18%)
$S2'$	25 (49.02%)	5 (9.80%)	21 (41.18%)	33 (66%)	1 (2%)	16 (32%)
$S1''$	40 (78.43%)	3 (5.88%)	8 (15.69%)	37 (74%)	3 (6%)	10 (20%)

Table A.6 Logistic regressions on aversion to risk inequality

Variable	(1) choosing option B in $S1$	(2) choosing option B in $S2$	(3) choosing option B in $S1$
$S1'$	-0.94^{**}		
	(0.38)		
$S1'$xMI	0.88		
	(0.60)		
$S2'$		-1.38^{***}	
		(0.40)	
$S2'$xMI		0.43	
		(0.58)	
$S1''$			-0.21
			(0.39)
$S1''$xMI			-0.03
			(0.56)
MI	-0.23	0.12	-0.23
	(0.51)	(0.52)	(0.51)
Intercept	1.68***	1.54***	1.68***
	(0.36)	(0.36)	(0.36)
Observation	202	202	202
Log Likelihood	-110.17	-116.60	-106.06
Akaike Inf. Crit.	228.35	241.20	228.35

Table notes: the full sample is used. Standard errors are clustered at the household level. Numbers in parenthesis are standard errors. Statistical significance is indicated as follows: *p<0.1; **p<0.05; ***p<0.01.

Table A.7 Logistic regressions predicting choice of option B in the household risk task

Variable	Coefficient (Std.Err.)
married	0.98^{***}
	(0.33)
years living together	-0.03
	(0.03)
number of common children	-0.09
	(0.17)
Intercept	0.95^{***}
	(0.21)
Observations	707
Log Likelihood	-395.67
Akaike Inf. Crit.	801.35

Table notes: the full sample is used. Standard errors are clustered at the household level. Statistical significance is indicated as follows: *p<0.1; **p<0.05; ***p<0.01.

Table A.8 Multinominal logistic regressions predicting switching behaviors between symmetric and asymmetric situations

		$S1'$	$S2'$	Pooled
		(1)	(2)	(3)
married	$Switching = 1$	-3.50*	-1.20	-2.10*
		(1.98)	(1.40)	(1.18)
	$Switching = -1$	-1.16	-1.40**	-1.27**
		(0.91)	(0.71)	(0.54)
number of common children	$Switching = 1$	0.85	0.77	0.61
		(0.72)	(0.93)	(0.52)
	$Switching = -1$	-0.11	0.74*	0.38
		(0.49)	(0.39)	(0.29)
years living together	$Switching = 1$	0.14*	-0.12	0.05
		(0.08)	(0.15)	(0.06)
	$Switching = -1$	0.07	-0.03	0.01
		(0.05)	(0.05)	(0.03)
common bank account	$Switching = 1$	-2.35**	-0.14	-1.29*
		(1.19)	(1.06)	(0.74)
	$Switching = -1$	-0.30	0.03	-0.11
		(0.66)	(0.53)	(0.40)
Intercept	$Switching = 1$	-1.97***	-1.87***	-1.92***
		(0.53)	(0.67)	(0.40)
	$Switching = -1$	-1.52***	-0.71*	-1.07***
		(0.44)	(0.37)	(0.28)
Observations		101	101	202
Log Likelihood		-62.65	-71.54	-139.94
Akaike Inf. Crit.		145.31	163.08	299.88

Table notes: the full sample is used. Numbers in parenthesis are standard errors. Statistical significance is indicated as follows: *p<0.1; **p<0.05; ***p<0.01.