On the inefficiency of household risk sharing: the role of inequality

Jiakun Zheng* Hélène Couprie† Astrid Hopfensitz‡

August, 2020

Abstract: A growing literature questions the validity of the household efficiency assumption of so-called collective models. Experimental evidence (Beblo et al., 2015) shows that a couples income allocation choices are sensible to the level of intra-household inequality which may hinder efficiency. In this paper, 101 real couples participated in a controlled experimental risk-taking task, that presents variations in household income risk and the level of risk-inequality, controlling for ex-ante income inequality. A majority of couples present a perfect risk-sharing pattern. However a significant proportion of couples experienced efficiency wastes due to the fact that households put a higher weight on men's individual risks. What could be interpreted as a male bread winner pattern, takes the shape of a preference for male's income stability.

Keywords: Household risk preferences; Individual risk preference; Informal insurance; Experiment; Inequality aversion

JEL Classifications: C91; C92; D19; D81

*School of Finance, Renmin University of China and China Financial Policy Research Center, No.59 Zhongguancun Street, Haidian Dist., Beijing 100872, P.R.China.
Email: jiakun.zheng@outlook.com.
†Université de Cergy-Pontoise (THEMA), 95011 Cergy-Pontoise Cedex, France.
Email: helene.couprie@u-cergy.fr.
‡Toulouse School of Economics, University Toulouse Capitole, 31000 Toulouse, France.
Email: astrid.hopfensitz@tse-fr.eu.

1 Introduction

Individuals do not take their decisions in isolation from social interactions: the most prominent example concerns decisions taken in families and households. Nowadays in Europe the couple is the main economic entity with respect to households.[1] Despite the strong progress in the modeling of households since Becker (1981), interactions that take place between members of a household remain largely unstudied. This is partly due to the fact that most of them escape markets and statistical observation. As a consequence of this invisibility, scientific validations remain weak. This paper tests experimentally household models in a risky decision-making context. It provides novel evidence on behavioral drivers for couples and reveals the necessity to consider intra-household risk inequality aversion.

Households provide protection to individuals in an uncertain environment. This aspect is crucial in developing economies who do not have proper institutions to provide social protection, or insurance markets (see e.g., Townsend, 1994; Cox and Fafchamps, 2007; Alger and Weibull, 2010). In this context, many efficiency tests of household risk sharing have been implemented and rejected econometrically (Cochrane, 1991; Udry, 1996; Mazzocco and Saini, 2012), and in field experiments (Duflo and Udry, 2004; Robinson, 2012). The question of how households take and share risks is also of interest for Western European Countries. In this case, the focus is not on climate and rainfall consequences but more on understanding how modern couples take decisions that imply idiosyncratic incomes for its members. In a context where there is a strong risk of economic crisis and where employment insecurity tends to grow, localisation choices, fertility choices or employment decisions, have different consequences for the future incomes of the man and the woman in the couple, but also on the income risk level faced by each household member.

In a traditional male bread winner model, a household would choose to favor the income flow of the man. Nowadays, the question is: how do modern couples take their decisions regarding the share of risk? Are they efficient in the sense that they pool the household income without considering who bears the risk?[2] As argued earlier, such efficiency is plausible for established couples, however in this situation, it requires that couples are able to make binding commitments regarding future intra-household transfers. This possibility is suspicious regarding the rise in divorce rates of modern societies. As a consequence, couples might take into account the distribution of individual incomes and risks to take decisions. These are the questions we are going to explore for France, a country that presents a historically strong focus on equality and for which the fear of income insecurity is traditionally important.

From a theoretical perspective, these past decades have witnessed the emergence of so-called collective household models (Chiappori, 1988; Chiappori and Ekeland, 2006) that are based on the fundamental assumption of efficiency. Empirically tractable, with powerful interpretations in terms of intra-household inequalities (the sharing rule), collective models are particularly appealing

[1] 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).

[2] According to the mutuality principle (Gollier, 2001), efficient behavior inside a household implies that only aggregate wealth in a given state of the world matters.

(Vermeulen, 2002, for a survey). There are strong indications that households are indeed motivated by efficiency. Household members choose each other. They share values and objectives, altruism and information through repeated life-sharing interactions, children and love. However testable restrictions of these models are rarely rejected in the literature using household demand data, partially because of inadequate specifications or weak rejection powers of available efficiency tests as argued by Dauphin et al. (2018). Besides this, one must note that the most general version of these models is not identifiable (Chiappori and Ekeland, 2009). It is of common econometric practice to assume specific untested parametrizations such as separable individual sub-utilities to achieve identification. Therefore, econometric methods largely fail in validating or invalidating the assumptions of household models.

Laboratory experiments avoid some of these drawbacks and can bring new insights. According to recent work on European couples, efficiency is questionable in various informational contexts. Cochard et al. (2016) observe behavior by couples in social dilemmas and find non-negligible efficiency waste in games where individual behaviors and earnings are set unobservable to partners. Couprie et al. (2020) observe inefficiencies due to stereotyped perceptions of productivity in the context of joint household production and couple-level payoffs. Munro (2018) provides a detailed and comprehensive survey of experimental tests of household efficiency. Regarding household behavior under risk, at the exception of Bateman and Munro (2005), most experiments in western countries compare individual versus joint decisions, for risk situations concerning couple-level payoffs. Results show that the balance of bargaining power in the couple matters. Braaten and Martinsson (2015) show that the more risk averse spouse tends to have more to say in a couple's decision; De Palma et al. (2011) find the opposite, with a balance of powers that becomes more and more favorable to women with repetition. Abdellaoui et al. (2013) show that the balance of bargaining power and individual risk preferences poorly explain couples' decisions under risk. However, in all three papers payoffs are directly computed at a couple level. Thus they do not represent the additional dilemma dimension that couples face when risk and payoffs are individual.

Our work is also related to a recent line of research that studies other-regarding preferences in risky environments. Extending the seminal work by Fehr and Schmidt (1999), Bolton and Ockenfels (2000), Charness and Rabin (2002), and others, these studies aim at understanding how risk decisions which have impacts for self and others, are influenced by social preferences. Fudenberg and Levine (2012) show that it is impossible to cope with the independence axiom and other regarding preferences at the same time, i.e., ex-ante and ex-post fairness. In a more recent work by Saito (2013), a model called inequality aversion model (EIA) is axiomatized by only considering ex-ante and ex-post fairness. Brock et al. (2013) further provide experimental evidence for the validity of this model.[3] To the best of our knowledge, all of these studies study behavior only in situations where subjects do not know their interaction partner. There is thus a need to integrate this kind of analysis in the household decision-making context.

In this paper, we present an experiment on choices by couples with respect to lotteries implying a strong intra-household inequality with respect to risk. A part of the experiment presents an

[3] However, Krawczyk and Le Lec (2016) make some critics on these findings.

asymmetric dilemma about who bears the income risk in the couple. Spouses take decisions jointly but receive individual payoffs, a case favorable to efficiency and very close to real-life behaviour. We are going to show that couples do react to intra-household risk inequalities in a way that significantly contradicts income-pooling attitude.

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 the models' performance is 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 the first six decision situations. 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 behavioural 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 consisted 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 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' individual 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 both spouses receive the same individual risk payoffs as well in the risky as the safe option. Note that on the individual level all options share the same expected value of 250.[4] 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 independent of the resolution of the risk the same payoff, i.e. either 150 or 350. Therefore 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

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

Figure 1 Symmetric decision situations in the household risk task

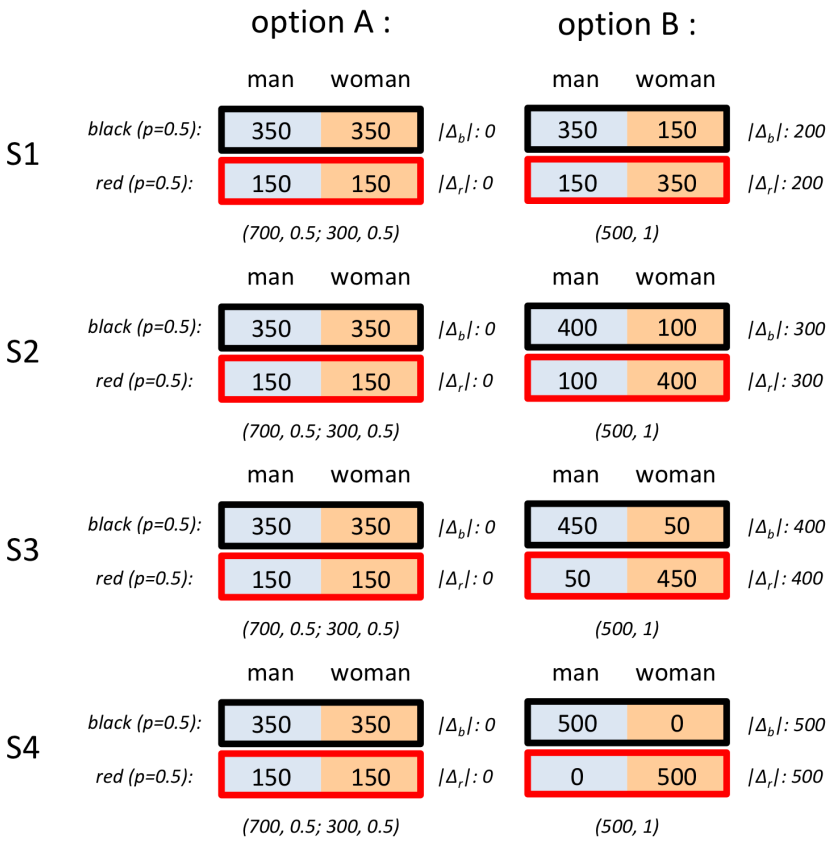
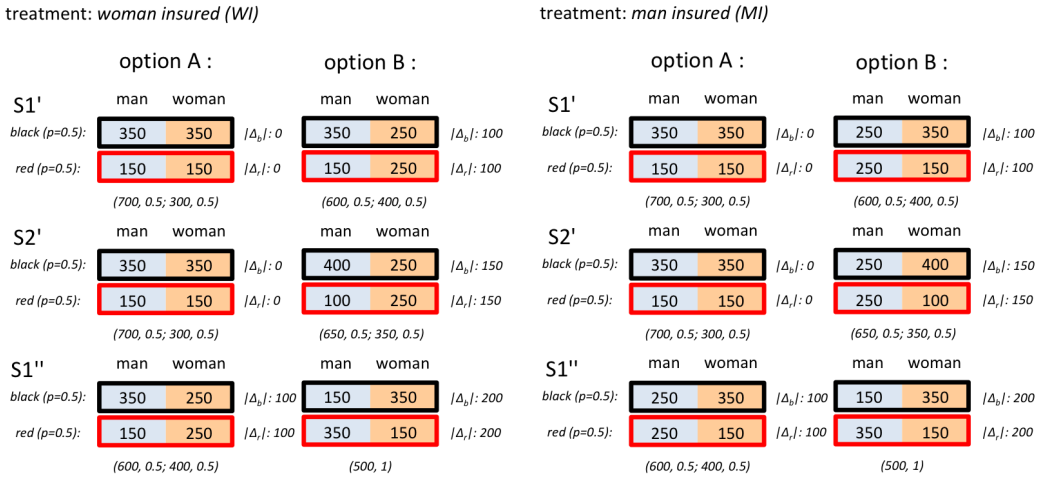


Figure notes: from S1 to S4, inequality in spouses' payoffs is gradually increased in option B. Colored boxes display individual payoffs. The aggregate lottery on the household level is presented in parenthesis.

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 $|\Delta_r|$) 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). Dependent 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 individual 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.

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



2.2 Predictions

In order to interpret our experimental results, we propose a model that embeds several behavioural motives that have been previously observed to be of relevance in these types of situations. We expect that behavior by households will be influenced by: (1) the overall stakes to be gained by the household, (2) risk preferences by the individual household members, adjusted for their bargaining power and (3) inequality in payoffs across household members. These three objectives can be combined in the following objective function for the household:[5]

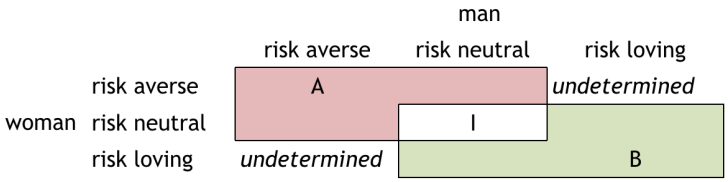
$$V(\mathbf{p}) = E^{\mathbf{p}}\left[\lambda^H u^H(x^W + x^M) + \lambda^W u^W(x^W) + \lambda^M u^M(x^M) - \lambda^{post}|x^W - x^M|\right] \quad (3)$$

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^{post} 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-post payoff allocations.

For ease of presentation and testing, we chose to keep the model simple. However, it is theoretically possible to introduce ex-ante inequality aversion, which would depend on intra-household expected incomes differentials (i.e., $\lambda^{ante}|E^{\mathbf{p}}x^W - E^{\mathbf{p}}x^M|$ with $\lambda^{ante} \geq 0$). Our experiment was designed such, as to control for such a parameter (i.e., λ^{ante}) since the expected value of individual payoffs was held constant across tasks and treatments. For this reason we will ignore its effect in

[5] This model can be trivially extended to a model with more than two persons. For ease of notation, we stick with this two-person model. Notice here 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.

Table 1 Predictions in case of bargaining for situations S2, S3 and S4



the remaining of the discussion. We could also have introduced asymmetry in the inequality aversion penalty parameter (i.e., λ^{post}). However, it would harm identification of the bargaining power parameters and is not our basic focus since previous work has shown that inequality aversion is highly symmetric in french couples. Let us now discuss the interpretations of this model for three reference situations.

The simplest case (which we denote **case I: Income-pooling**) occurs whenever λ^M, λ^W and λ^{post} equal to zero. In this situation the household only focuses on the sum of both spouses' incomes $x^W + x^M$. We may in addition assume that the household acts like an agent with vNM expected utility and will thereby solely focus on the joint household payoff.[6] Over all the seven decision situations of the household risk task, option A is always designed to be 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. More specifically, a risk averse couple should choose always option B, a risk neutral couple always indifference (I) and a risk loving couple always option A. Note that predictions are independent of treatment.

Whenever λ^H and λ^{post} equal to zero (**case II: Bargaining**), the objective function of the household coincides with a convex combination of each member's individual sub-utility, which is the usual specification of collective household models. The remaining parameters are such that $\lambda^M + \lambda^W = 1$ and $\lambda^M, \lambda^W \quad [0, 1]$. These parameters can be interpreted as a measure of male or female bargaining power within a household. The bargaining power parameter might be higher due to better outside options of the individual but may also reflect that the household chooses for whatever reason (e.g. altruism) to put more weight on a specific household member. If λ^W equals to zero, we are in the traditional male bread-winner decision-taking situation.

The predictions depend on individuals' attitudes towards risk that are elicited during the first stage. In total, we can classify households into 9 (i.e. 3×3) different categories. Table 1 summarizes the predictions of household decisions for each category at the symmetric decision situations.[7] 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 extent to which spouses' risk preferences differ (see Table A.1 in Appendix). When both spouses have the same risk preferences,

[6] 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).

[7] 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.

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 ex-post earnings inequality (i.e. λ^H, λ^W and λ^M equal to zero).[8] A purely inequality averse household seeks to minimize $E^{\mathbf{p}^{\square}}|x^W - x^M|$). Since option A generates less ex-post pay-off inequality than option B, it would be chosen in all seven situations.

Most likely, all elements will play a role in behavior. We therefore structured the experimental situations such as to be able to detect the presence of risk-inequality aversion, when λ^H, λ^W and λ^M are all positive. Specifically the design presents a dilemma between equality and both income-pooling concerns and risk aversion. We do so because based on previous work the majority of couples is expected to show concerns for income pooling and risk aversion. Such couples are expected to choose B if $\lambda^{post} = 0$. Thus when income pooling and risk averse couples choose A, we can take this as evidence that λ^{post} has a strong enough weight for these couples.

3 Experimental methods

Our experiment consists of two phases with two types of tasks: an individual risk decisions phase and a household risk decisions phase. Participants first completed the individual risk task. This task allows us to measure individual attitude towards risk and will be used to understand household risk taking. Participants responded to the individual risk task on their own. For the household risk task participants joined their partner to respond jointly. Couples were randomly assigned into one of two treatments, *woman insured* (WI) versus *man insured* (MI). In the following subsections, we describe each phase 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 1 year, but did not need to be married.[9] The announcements further specified that each participant would earn, dependent on their decisions, an amount between 20 and 60 € for their participation.[10]

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

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

[9] 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.

[10] The experiment included a number of other experimental parts with respect to 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.

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 time limit.

The experiment was conducted by paper and pencil. Considerable care was taken to explain the instructions as simply as possible, and decision sheets were presented in a graphically intuitive way. Computers were avoided due to the large variance in 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 short 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 in order to decide which decisions would be paid out. This required the participant tossing a dice under supervision or picking a random number from a box containing 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. Participants were then 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 couples had to make a choice between a "safe" option A and a "risky" option B. In case of being indifferent between the two, couples could choose option I. If option I was chosen, option A or option B were randomly selected to determine the payment with one half probability. Spouses were paid their individual payoffs from this task. We took great care in explaining that each participant would only learned his or her own total 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.[11] 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 this criteria to identify participants that make consistent decisions.

This task is useful to quantify individual risk aversion which is required for predicting households' decisions. We will use the number of the decision at which a participant switches from option A to option B.[12] As discussed above, a risk neutral participant will have a risk aversion level of 4, denoted $RA = 4$. A more risk averse participant will have an $RA > 4$, while a more risk seeking participant will have an $RA < 4$.

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 own table and were provided an envelope to return and seal 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), we will then give raw results for the household risk task (section 4.2) before finally exploring the behavioral motives of couples (section 4.3).

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

[11] 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 man and woman. This was to help participants easily understand for whom their decisions were made and what would be their individual payoffs if an option was chosen.

[12] 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.

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 a good socio-professional status. We also find that 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 our individual 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. When interpreting the behaviours across tasks, we will restrict our sample to participants categorized as consistent at an individual level (168 individuals) or at the couple level (73 couples). We will also carefully check for the effect of these restrictions on the robustness on our results.

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).[13] 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 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).[14]

We also find no significant correlation between spouses' individual risk attitudes ($\rho = 0.12$, p-value = 0.32) and overall there is no significant difference in spouses' risk attitudes (Paired Wilcoxon signed-rank test p-value = 0.32). Also, 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 our further analysis we will 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. Table 2 reports the numbers of couples in each category. The majority: 43 out of 73 couples (59%), have two risk averse spouses.[15]

Table 2 Distribution of individual risk preferences in couples

		man		
		averse	neutral	loving
woman	averse	43	7	6
	neutral	9	3	1
	loving	1	1	2

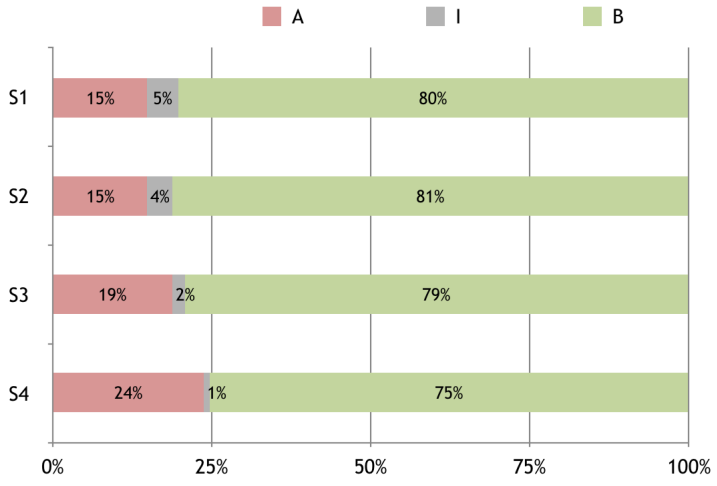
Table notes: here we only consider these couples with two spouses being consistent in the individual risk task. In total, there were 73 consistent couple.

4.2 Household risk taking: aggregate results

Figure 3 represents couples' choices in the four symmetric decision situation. Across all situations at least 75% of couples favor option B which is safer at the household level, despite the fact that individuals bear a higher risk and intra-household ex-post inequality. When the dilemma becomes stronger ($S1$ versus $S4$), we see an increase in couples choosing option A from 15% to 24% (Wilcoxon signed-rank test p-value = 0.11). Household choice patterns also slightly differ between $S1$ and $S4$ (Chi-test p-value = 0.09)

Figure 4 shows aggregate choices by couples in the three asymmetric decision situations. Recall that women in treatment WI (respectively men in treatment MI) received a reduction of individual risk in option B in situations $S1$ and $S2$ and in option A in situation $S1$. In each of the three asymmetric decision situations at least 66% of couples chooses option B in treatment MI. This

Figure 3 Histogram of decisions by all couples in the symmetric decision situations



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

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

[15] The distributions of couples by combination of spouses' risk preferences do not differ significantly between the two treatment groups (Chi-2 test p-value = 0.13). We also do not find any difference in RA between participants in treatment WI and MI for either gender.

implies no significant decrease with respect to the percentages choosing option B in the symmetric decision situations (Chi-test p-value = 0.41). In treatment WI the pattern is strikingly different, where in situation $S2$ only 49% of couples select option B. We can reject the null hypothesis that couples take risk decisions independent of decision situations for treatment WI (Chi-test p-value = 0.04).[16]

We will now discuss these observations in light of the general behavioral household model of section 2.2.

4.3 Behavioral Motives

In light of these results we will not discuss the implications concerning the parameters of the previously introduced behavioral household model. For identification and coherence reasons, we focus in this section only on couples with two consistent and risk averse spouses (see Table 2). The restriction on risk averse spouses is necessary to analyse the bargaining case (i.e. case II). The presented results are also robust with respect to the sample of consistent spouses or even to the full sample.

4.3.1 Income-pooling

In the case of income pooling, the household decision will be solely influenced by the total income by both partners, i.e. $\lambda^H > 0$, whereas the other parameters of the model will be zero. This income-pooling motive reflects the strength of the efficient risk-sharing motive in household decision.

Our results provide strong support for an income pooling motive in household decision making. In line with the results discussed in the previous section, across all the symmetric decision situations more than 80% of risk averse couples choose option B; and 91% choose option B in situation $S1$ (see Figures 3 and A.5 in Appendix B). In all the symmetric situation both individual risk and ex-post payoff inequality are higher (or equal) in option B than in option A (see Figure 1). Since we observe a large majority of couples choosing option B, we conclude that households

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

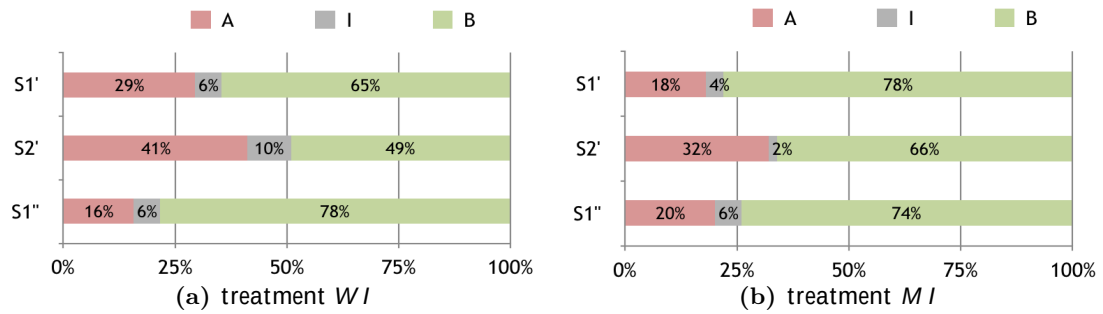


Figure notes: there were 51 couples in treatment WI and 50 couples in treatment MI.

[16] These results, obtained on the full sample, are also robust to other sample choices that exclude inconsistent or even risk-lover participants.

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 (Wilcoxon signed rank test p-value < 0.001).

Result 2: In the symmetric situations, approximately 80% of the couples prefer a reduction of risk at the household level over a reduction of risk at the individual.

4.3.2 Inequality aversion

Besides the importance of income pooling, we will now analyze the importance of concerns for income inequality aversions.[17] Recall that in the four symmetric decision situations, option A is characterized by holding a high household risk but no ex-post income inequality; in contrast option B has lower household risk and implies ex-post income inequality. Income inequality and individual income risk increase across the four situations, being the highest in situation $S4$.

To observe the importance of pure ex-post income inequality aversion, while holding individual income risk constant, we need to consider results from situation $S1$. (see Figure 1). Indeed a small but significant part of households (9.3%) seems to be affected by the ex-post inequality (not rejected against zero at the 5% level). We can therefore say that for a small but significant proportion of couples, the parameter λ^{post} is positive.

The combined effect of risk and income inequality aversion can be observed using all four situations. We observe that the proportion of couples choosing option A is slightly increasing from situation $S1$ to $S4$. The difference between situations $S1$ and $S4$ is significant at the 10% level (Wilcoxon signed-rank test p-value=0.09). When the dilemma is strongest ($S4$) about 12% of couples are thus motivated by concerns for either their own income or risk (see Table A.5) [18].

Result 3: More than 10% of the couples show a preference for reducing inequalities instead of minimizing household income risk.

4.3.3 Gender effect

To analyse asymmetries in behavior with respect to outcomes for men or women, we focus on results from the first two asymmetric decision situations. In these situations either the woman (WI) or the man (MI) is insured in the situation where household risk is low. Therefore only the uninsured member of the household faces a dilemma between individual risk (low in option A) and household income risk (low in option B).

We observe a sharp decline in the proportion of couples choosing the safe household option (B) when women were insured and thus the dilemma weighted on men (WI). We can clearly reject the null hypothesis that couples made risk decisions independent of decision situations (Chi-test p-value < 0.001). No such effect is observed in the treatment where men were insured and thus

[17] We recall that for ease of identification we controlled in the design ex-ante income inequality: the expected income at the individual and household level was equal in all situations.

[18] This percentage is even higher in the full sample see Figure 3 and 4, it is coherent since the restricted sample is composed of risk averse spouses that present a stronger insurance need.

the dilemma weighted on women (MI: Chi-test p-value = 0.31). Actually, there are only 44% of couples in treatment WI selecting option B in situation $S2$, a large difference from the average proportion in the other six decision situations, where the proportion is around 82.67%. Apparently, when man's income is correlated with household one, risk sharing (option B) is much easier to achieve.

If households took gender neutral decisions, couples in the two treatment groups would make similar decisions in all situations.[19] This is not what we observe, we conclude that households are more sensitive to the risk of men than that of women, with the consequence that $\lambda^M > \lambda^W$.

Result 4a: On average, households put significantly more weight on reducing male's than female's risk.

To answer the question which households are able to share risk even if this implies intra-household inequality, we consider results from logistic regressions. We find that married couples have a significantly higher probability of choosing option B in situation $S2$ and $S2$ than couples with other types of relationship (see Table A.6 in Appendix B). Interestingly, other household characteristics, like the number of years living together, having common children, joint bank account, etc., which correlate significantly with the marriage status, have no explanatory power on household risk decisions[20]. The comparison between situations $S2$ and $S2$ seems to suggest that marriage status plays a crucial role in household risk sharing and it is particularly true when there is an asymmetry in individual risk bearing. It appears indeed that about 80% of married couples choose option B in situation $S2$, whereas only 42.86% of non-married ones do so.

Choosing option B in situation $S2$ leads to safer household payoffs but higher ex-post inequality and individual risks. Therefore, married couples put a higher weight on expected utilities from joint household payoffs. It could be due to higher intrinsic commitment abilities of these specific couples (better communication and trust) or improved enforcement mechanisms (through family norms or marriage contract).

Result 4b: Married couples put a higher weight on expected utilities from joint household payo s.

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.

[19] We recall here that there is no significant difference in risk aversion across gender.

[20] Robustness analysis confirm our result. We find a similar effect using the restricted sample for the regression analysis. It is also possible to better describe the diversity of couples' financial arrangements, this would never be significant and the marriage coefficient remains significant.

Studying couples preferences for resource allocation when these imply either a loss in efficiency or an increase in inequality are one way to understand the persistence of gender inequality. In France, previous results showed strikingly symmetric attitudes of men and women (Cochard et al., 2016). Results from the present study introduce a caveat concerning the symmetry of behavior. Indeed while most couples agree on a risk sharing outcome when situations are symmetric, asymmetries give rise to differences in outcomes dependent on whether the man or the woman carries the risk. Our results suggest that when men are experiencing the trade-off between individual risk and household risk, that their individual risk preferences are more often accounted for. This could be due to gender norms, to unbalanced bargaining power or altruistic attitudes in favor of males.

Our results also add to our understanding with respect to household attitudes towards risk. 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 situation where returns and risk are on the individual level. Decisions with respect to health or labor market risks are likely to have consequences for the individual that can not be easily equalled out by side payments. We therefore focus on joint choices with respect to 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 face in reality: when choosing a living location, accepting a job, and even choosing the couple's income tax system. Indeed, these decisions have consequences on individual earnings patterns and volatility, through employment risk, promotion probability and intra-household inequality.[21]

Perfect risk-sharing (which implies prioritizing reduction in household's income volatility) is the dominant attitude. However, we found strong evidence for inefficiencies in household decision-making, especially in the presence of strong inequalities. In a significant proportion of households, when the man's income is exposed to risk, household's priorities change in order to reduce risk for men, even though household's income (and the female's income) volatility increases.

To understand this result, we have to understand the link between intra-household inequality and risks. The risk-sharing mechanism in Western European households, takes mostly the shape of labour supply adjustments, that generate a negative correlation between spouses' income variation (and increase intra-household inequality). These adjustments are studied in the old-fashioned 'added worker effect' literature which considers the woman's labour supply as the sole adjustment mechanism. In fact, the decisions taken by our couples are in line with this idea by reducing risk for men in asymmetric situations. This might seem a contradiction with some (wrongly) perceived stylised facts such as: men take more risk and are more often entrepreneurs with risky earnings patterns whereas women are more risk averse and often take safe civil servant employments. When incorporating labor supply adjustment, it becomes clear that women's income is in practice influenced by a strong volatility due to family risk; the higher dispersion of men's income is mainly due

[21] Couples can choose between individual and joint income taxation. The progressivity of the individual taxation system tends to reduce intra-household inequalities. The joint tax system is known to increase intra-household inequalities by over-taxing the poorer individual within the household.

to exposure to a larger range of wage scales. While these effects are mainly driven by institutions, we focus on the behavioral aspects. Hence, our experiment emphasizes the behavioral content of this reality. To our opinion, our result is affected by a strong gender norm. The fact that more traditional couples (married couples) take these decisions reinforces this view.

Finally, we could also interpret our results in terms of the interaction between formal and informal insurance. Since we observe an impact of asymmetries between who is receiving insurance in the household, we should be particularly careful in the design of policies that protect and reduce the individual risk for only one partner within a household.

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.

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, 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. 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.

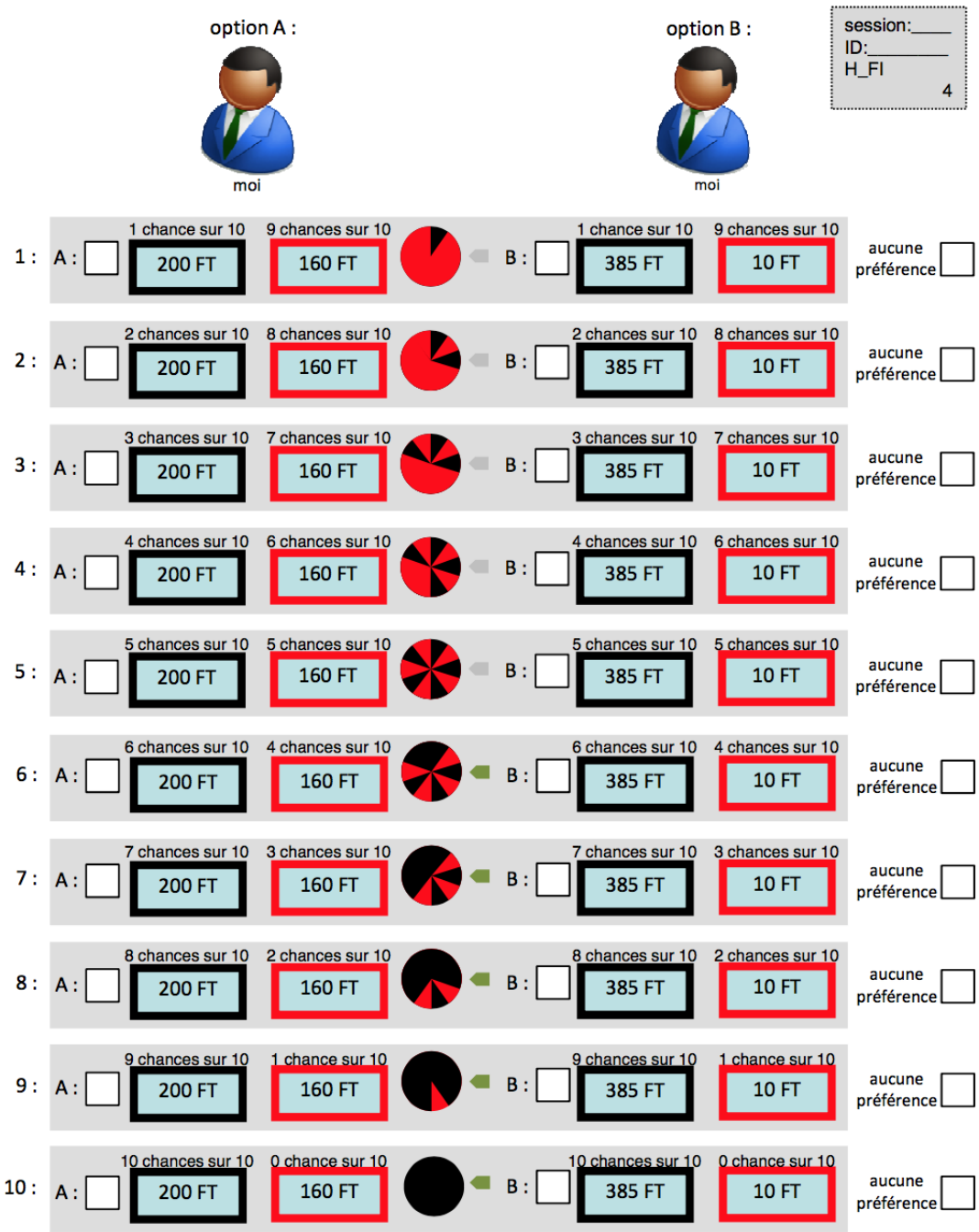
Vermeulen, F. (2002). Collective household models: principles and main results. *Journal of Economic Surveys 16* (4), 533–564.

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.

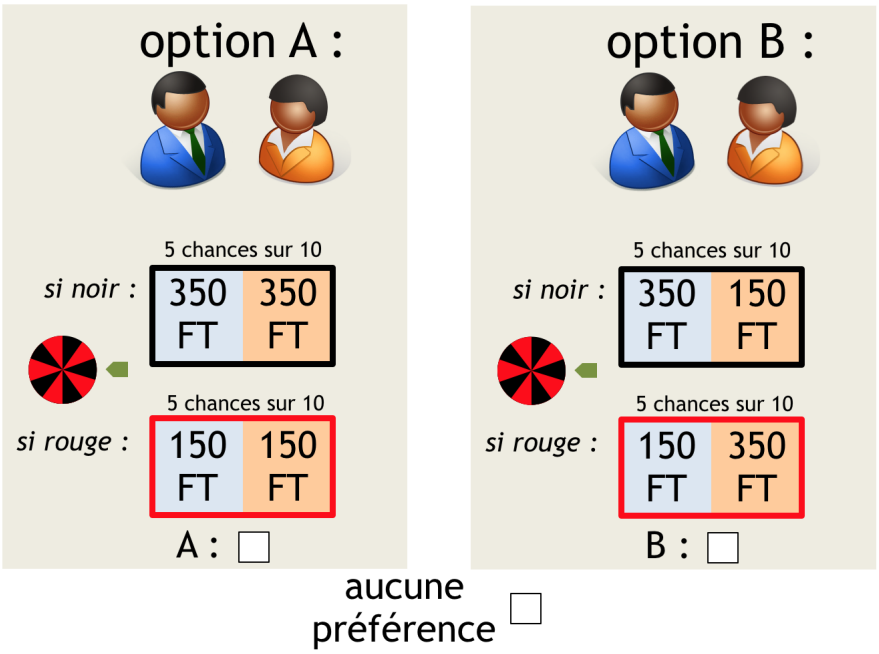
Even though you will make ten decisions, only one of them will be randomly selected by throwing a ten-sided die, whose faces are numbered from 1 to 10 and end up affecting your earning. You will not know in advance which decision will be used. All decisions have equal chance of being relevant for your 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	$(B\ ?\ A)$	$(\mathbf{B}\ \mathbf{B}\ \mathbf{A})$	$(\mathbf{B}\ \mathbf{B}\ \mathbf{A})$
	neutral	$(\mathbf{I}\ \mathbf{A}\ \mathbf{I})$	$(I\ I\ I)$	$(\mathbf{I}\ \mathbf{B}\ \mathbf{I})$
	loving	$(\mathbf{A}\ \mathbf{A}\ \mathbf{B})$	$(\mathbf{A}\ \mathbf{A}\ \mathbf{B})$	$(A\ ?\ B)$

(a) treatment WI

		man		
		averse	neutral	loving
woman	averse	$(B\ ?\ A)$	$(\mathbf{I}\ \mathbf{A}\ \mathbf{I})$	$(\mathbf{A}\ \mathbf{A}\ \mathbf{B})$
	neutral	$(\mathbf{B}\ \mathbf{B}\ \mathbf{A})$	$(I\ I\ I)$	$(\mathbf{A}\ \mathbf{A}\ \mathbf{B})$
	loving	$(\mathbf{B}\ \mathbf{B}\ \mathbf{A})$	$(\mathbf{I}\ \mathbf{B}\ \mathbf{I})$	$(A\ ?\ B)$

(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 Table 1). Similarly, when $\lambda^M = 1$ and $\lambda^W = 0$, the predictions correspond to the second row in Table 1.

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 di□erence 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 $|RA^W - RA^M|$. 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 by couples having two risk averse spouses

	treatment WI (25 couples)			treatment MI (18 couples)		
situation	option A	option I	option B	option A	option I	option B
$S1$	0 (0%)	3 (12%)	22 (88%)	1 (5.56%)	0 (0%)	17 (94.44%)
$S2$	2 (8%)	1 (4%)	22 (88%)	1 (5.56%)	0 (0%)	17 (94.44%)
$S3$	4 (16%)	1 (4%)	20 (80%)	2 (11.11%)	0 (0%)	16 (88.89%)
$S4$	4 (16%)	0 (0%)	21 (84%)	1 (5.56%)	0 (0%)	17 (94.44%)
$S1$	6 (24%)	1 (4%)	18 (72%)	1 (5.56%)	1 (5.56%)	16 (88.89%)
$S2$	12 (48%)	2 (8%)	11 (44%)	5 (27.78%)	0 (0%)	13 (72.22%)
$S1$	3 (12%)	1 (4%)	21 (84%)	3 (16.67%)	0 (0%)	15 (83.33%)

Table A.6 Logistic regressions predicting choice of option B in decision situations $S2$ and $S2$

	$S2$	$S2$
	(1)	(2)
PACS	1.35	0.25
	(1.14)	(0.71)
married	1.53	1.61
	(0.92)	(0.67)
number of common children	0.33	−0.37
	(0.56)	(0.35)
years living together	−0.04	−0.02
	(0.06)	(0.04)
common bank account	0.14	0.08
	(0.64)	(0.49)
Intercept	1.02	0.08
	(0.39)	(0.34)
Observations	101	101
Log Likelihood	−46.01	−66.14
Akaike Inf. Crit.	104.02	144.27

Table notes: for both regressions in columns (1) and (2) 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.