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Decision-Making under Risk: From Individual Preferences to Couple Decisions

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Abstract

There is a growing literature that studies intrahousehold decisions, although few papers study risk taking behavior. Yet, risk is unavoidable in many couple decisions, including residential location, labour supply, children or financial investments. In this paper, we consider couples facing financial risky decisions. Such decisions have implications for the couple and are thus likely to be made collectively by the spouses. Moreover, spouses may have altruistic preferences. Using a sample of 110 couples in former East Germany, we decompose the process leading from individual preferences to couple decision under risk, taking into account both spouses bargaining powers and altruism.

Keywords. Bargaining power, Intra-Household Experiments, Household decision-making, Risk, Savings and consumption, Altruism, Empathy.

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1 Introduction

There is a growing literature in the study of intrahousehold decisions (see Munro, 2018). More and more experiments analyze how decisions are made within couples, although very few of them are interested in risk taking behavior. Yet, risk is unavoidable in many couple decisions, which include residential location, labour supply, children and financial investments. In this paper, we consider couples financial risky investment decisions.

Since decisions made under risk, such as investment decisions, have implications for each spouse, these decisions are likely to be made collectively by the couple. To understand couple decisions, rather than thinking of the couple as a single decision-maker (unitary model), it is crucial to recognise that each spouse in the couple is a decision-maker (non-unitary model). This leads us to examine how spouses' preferences aggregate, i.e., to study the decision process that leads from individual preferences to couple decisions under risk. A good understanding is important to anticipate the effects of public policies which attempt to modify household decisions, such as social-welfare programs, income taxation for households, and legislation governing divorces (see Chiappori & Mazzocco (2017) for more details).

There is a very thigh legislation in Europe about the knowledge of individual risk attitude before any investment advice can be provided. See the MiFID regulation is Europe, which has been enforced 2007 and the analysis of French risk questionnaires by de Palma & Picard (2010). The legislation has been updated more recently with ESMA recommendations and the PRIIPS legislation. Interestingly, not a single word in this legislation appears concerning the level of risk a couple can bear, while often, financial decisions are joint decisions and aggregate the preferences and beliefs of each spouse.

Mazzocco (2007) studies the aggregation of individual preferences when each individual is risk-averse, has egoistic preferences and does not perfectly know the preferences of the other individuals. He shows that a group of such individuals making *ex ante* efficient decisions, and hence a couple, behaves as a single decision-maker if and only if the individual utilities belong to the harmonic absolute risk aversion class with identical shape parameter (ISHARA). Under these restrictions, the assumption of the unitary model that the household behaves as a single agent is therefore satisfied and the unitary and collective models generate the same outcomes in terms of risk taking (but not risk sharing). As highlighted by Munro (2018), the literature on intra-household experiments finds a widespread inefficiency of choices made by women and men in a couple, but has not examined the reasons.

In this paper, we develop an experimental procedure and propose an empirical setting to decompose the process leading from individual preferences to couple decision under risk recognizing that individuals may be more or less altruistic towards their spouse and may not perfectly know the preferences of their spouse, and that couple decisions may be affected by the relative bargaining power of each spouse. Specifically, we investigate the knowledge that an individual has about his/her spouse preferences by asking them to guess the replies of his/her spouse. This allows us to define a degree of empathy, capturing the ability of an individual to state accurate guess of his/her spouse's preferences. We find that imperfect knowledge plays a prominent role in this analysis since assuming that an individual has a perfect knowledge about his/her spouse preferences when it is not the case leads to misestimate his/her degree of altruism.

Assuming that each individual may (i) be altruistic towards his/her spouse in the sense that the s/he understands and takes into account the consequences of his/her choice on his/her spouse (see e.g., Chiappori, 1988); (ii) not perfectly know the preferences of his/her spouse (see e.g., Dellaert et al., 1998); and (iii) be risk-lover, we find that Mazzocco (2007)'s aggregation result may fail to hold, thereby justifying the experimental-based approach we take.

This paper relates to the literature on household experiments under risk and on bargaining power (see e.g., Bateman & Munro, 2005; de Palma et al., 2011; Munro, 2018, and references therein). By contrast with this literature, we consider spouses may have altruistic preferences and may not perfectly know the preferences of their spouse. Another related paper is Dellaert et al. (1998) who consider families with at least one child, a father and a mother and in which each individual is asked to guess the preferences of the other family members. By contrast with the present paper, the authors consider family holiday decisions in the absence of risk and relies on the random utility modelling.

The remainder of the paper is organised as follows. Section 2 describes the experimental design carried out on 110 couples in former East Germany. Section 3 examines aggregation of individual preferences when spouses are possibly altruistic and may not perfectly know each other. Section 4 develops the empirical strategy of the paper. Section 5 gives the empirical results and Section 6 concludes.

2 Experimental Design

We elicit levels of risk aversion using a *choice bracketing procedure*, i.e., investment series.[1] In each step of the bracketing procedure, an individual or a couple has to choose between a safe and a risky alternative. Potential payoffs and probabilities are always known to the individuals or

[1]Experimentalists rely on several risk assessment methods. One method consists in eliciting buying and/or selling prices for a given lottery using mechanisms such as a Vickrey auction or the Becker-DeGroot-Marschak procedure. As shown by Karni & Safra (1987), these mechanisms are however not incentive compatible when the object being valued is a lottery. Another method consists in observing choices that subjects make over lotteries that vary the prizes offered for given probabilities (e.g., Binswanger, 1980) or varying the probabilities of winning given prizes (e.g., Holt & Laury, 2002). This latter method is usually made operational by presenting a fixed array of paired alternatives to subjects and asking each subject to pick one of the two alternatives in each row. One of the disadvantages of this Multiple Price List (MPL) procedure is that it could be susceptible to framing effects, as subjects are drawn to the middle of the ordered table irrespective of their true values. Harrison & List (2004) consider the disadvantages of the MPL procedure, propose extensions which can address each, and evaluate those extensions in controlled laboratory experiments where they elicit measures of risk aversion and discount rates for individuals.

couples and, in a given bracketing procedure, the safe alternative is a sure amount ranging from the low outcome of the lottery to the high outcome of the lottery (see de Palma et al., 2011, All details about the bracketing procedures and the lotteries can be found in the Appendix).

2.1 Experimental sessions and participants

Seven experimental sessions were carried out from November 2005 to March 2006. Subjects were recruited from the city of Jena (Germany) via local newspaper advertisements, through community groups and using posters in the city center. Session sizes varied from 2 to 4 couples and were held at the experimental economics video laboratory of the Max Planck Institute of Economics in Jena. We recruited 110 couples for our experiment. At the beginning of the experiment, we asked a few warm-up questions to the spouses separately about themselves and about the couple (See Step 1, Section 1 in the Experimental Procedure sum-up below). The main characteristics are briefly summarised now.

Average payoffs were just above 50 € per individual – more than five times the median hourly post-tax wage for an adult working in the former East Germany in 2005. Ages ranged from 23 to 70, with a mean of 40. Approximately 46% of individuals stated that they were married to their current partner and all the couples in our sample were heterosexual. On average, couples had been together for 14 years (median of 10), with a maximum of 40 and a minimum of 1. On average, couples had 0.8 children together. Each spouse also had on average 0.4 children from previous union(s). These figures are quite representative of the German population (Lechner, 2001).

2.2 Progress of an experimental session

Before entering the video ? laboratory, couples were reminded that decisions would be implemented on computers (this information had already been provided in the invitation mail) and they were told that they could ask for help at any point in time during the experimental session. Finally, it was mentioned to the couples that the session would consist of several parts (no details concerning the different parts were provided at that point of time) and that instructions for each part would be delivered in due time.

Upon entering the video laboratory, couples were separated: each male entered one of the odd numbered cabins and each female entered one of the even numbered cabins.[2] The first section of the experiment was therefore conducted with the two spouses in different cabins; pairs then rejoined each other for the second section of the experiment.

The first section of the experiment started with the elicitation of the participants' socioeconomic characteristics (level of education, post-tax monthly salary, etc.). Next, the separated subjects

[2]The experimental economics video laboratory of the Max Planck Institute of Economics in Jena comprises 8 soundproof cabins. Each cabin provides in- and output for video- and audio signals. In addition, each cabin is equipped with a personal computer. See Baumann & Schmidt (2004) for details.

had to estimate their influence on the couple decision in every day life situations. After answering this questionnaire, each subject was endowed with 40 €. Then, the subjects went through nine investment series: in the first three series, they had to invest part or all of their own endowment into risky options, in the following three series, they had to guess the replies of their spouse to the questions of the first three series, and in the last three series they had to invest part or all of the couple endowment into risky options. Lastly, each subject stated what his/her spouse decisions in the first three series were. Before going through the series of risky investments, subjects were told that they would have to go through twelve investment series and that, at the end of the experiment, one series would be chosen at random and one of the choices in this series would be played for real.[3] The subjects were given details of how the payout procedures would operate only at the end of the experiment.

In the second section of the experiment, couples made choices jointly. Concretely, male partners were asked to join their female partners in their cabin. Couples went through six investment series. They had the possibility to discuss but no specific instructions as to how the couple decisions should be made were provided (and no explicit time limit was given). In this experiment, when spouses are together, they have each one a computer. They could go on to the next question only if both provided the same answer. By contrast, in the pretest (see de Palma et al., 2011), male partners joined their female partners and couple decision were made on the same computer, which favored the latter over the former for the control of the mouse.

The incentive system was a follows. First, one of the two partners had to randomly draw a card from a pile of five cards, one card being numbered one, two cards being numbered two, and two cards being numbered three. If the card numbered one was randomly drawn then the payoff-relevant decision was determined separately for each partner: the male partner went back to his cabin and each partner's paid decision was determined according to two random draws, one random draw to determine the series and the other random draw to determine which decision in the series. If a card numbered two was randomly drawn then the payoff-relevant decision made by one spouse separately for couple endowment: first, a random draw decided whether one of the female or one of the male decisions to invest the couple endowment would be paid, and second, two additional random draws were made in order to select the series and the decision in the randomly selected series. If a card numbered three was randomly drawn then the payoff-relevant decision made jointly by the couple was determined: two random draws were made in order to select the series and the decision in the randomly selected series.

The computer screens that subjects saw while going through the two sections of the experiment have been translated and reproduced in the Appendix. Additional material of the experimental sessions, like the written instructions and the payment procedures, is available upon request from the authors. Below, we summarise our experimental procedure.

[3]Payoff-relevant investments were preceded by a training series of ten investments.

3 Aggregation of Individual Preferences

Two types of models are commonly used to analyse decisions made by a household. First, the unitary model that assumes that the household can be represented by a unique utility function (i.e., it acts as a single agent). Second, the collective model that relaxes this assumption but that instead makes an assumption about how individual preferences are aggregated. Specifically, the full-efficiency collective model assumes that household decisions are *ex ante* efficient (i.e., on the *ex ante* Pareto frontier).

In this section, we first introduce a simplified version of the framework used by Mazzocco (2007) to study aggregation of individual preferences within couples (see also Browning et al., 2014, Chapter 6.3.). Then, we recall Mazzocco (2007)'s finding that the unitary model is a special case of the full-efficiency collective model, meaning that some couples can be represented using a unique utility function. We then generalise his result to the case in which spouses are possibly altruistic and show that it does hold or not depending on whether individuals within the couple do perfectly know each other or not.

3.1 Mazzocco (2007)

3.1.1 Mazzocco (2007)'s Setting

Consider two individuals, a woman F and a man M, who form a couple C and who share income risks. There are N commodities[4] and S states of the world, which realise with probabilities $\pi_1, ..., \pi_S$, with $\pi_s \geq 0$ for all $s = 1, \ldots S$ and $\sum_{s=1}^{S} \pi_s = 1$ and $\boldsymbol{\pi} = (\pi_1, \ldots, \pi_S)$. In each state s, woman F (resp., man M) receives some income y_s^F (resp.,y_s^F) and consumes a vector $c_s^F = \left(c_{s,1}^F, ..., c_{s,N}^F\right)$ (resp., $c_s^M = \left(c_{s,1}^M, ..., c_{s,N}^M\right)$) at prices $p_s = (p_{s,1}, ..., p_{s,N})$.

Assume that both spouses F and M are risk averse, are nonaltruistic (i.e., egoistic), and perfectly know each other. The nonaltruistic woman F (resp., man M) is characterised by individual preferences with corresponding indirect utility function V_F^F (resp., V_M^M) and is an expected utility maximiser with correspond expected utility W_F^F (resp., W_M^M).

Assume further that prices do not vary across states: $p_s = p$ for all $s = 1, ..., S$. This implies that woman F (resp., man M)'s indirect utility, V_F^F (resp., V_M^M), depends only on woman F (resp., man M)'s share of couple income, x_s^F (resp., x_s^M), in any state s. Then, x_s^F and x_s^M correspond to the sharing rule that governs the allocation of couple resources between spouses, meaning that, for all states s, $x_s^F = x_s$ and $x_s^M = y_s - x_s$ with $y_s = y_s^F + y_s^M$. We denote $\mathbf{x} = (x_1, \ldots, x_S)$ and $\mathbf{y} = (y_1, \ldots, y_S)$.

Lastly, assume that couple C makes *ex ante* efficient decisions, so that, as noted by Browning

[4]Consumptions are private, meaning that we do not consider the other members of the family, and in particular the children.

et al. (2014), it chooses $\mathbf{x}$ so so as to maximise the following expected utility:

$$W_C^C(\mathbf{y},\boldsymbol{\pi};\mu) \equiv \sum_{s=1}^S \pi_s V_C^C(y_s) = \mu W_F^F(\mathbf{x},\boldsymbol{\pi}) + (1-\mu) W_M^M(\mathbf{y}-\mathbf{x},\boldsymbol{\pi}), \quad (1)$$

$$= \sum_{s=1}^S \pi_s \left[\mu V_F^F(x_s) + (1-\mu) V_M^M(y_s - x_s)\right], \quad (2)$$

where μ and $(1-\mu)$ are woman F and man M's bargaining powers, respectively, which do not depend on the state s. The solution to this program is given by $\{x_s(\mu, y_s)\}_{s=1,\ldots,S}$.[5]

3.1.2 Mazzocco (2007)'s Aggregation

Mazzocco (2007) determines the conditions under which a couple can be thought as a single decision-maker, which happens when the ranking over income profiles $\mathbf{y}$ produced by W_C^C does not vary with the value of the bargaining power μ. This means that, for a given pair of income profiles $\mathbf{y}$ and $\mathbf{y}'$, $\mathbf{y}$ is preferred over $\mathbf{y}'$, i.e., $W_C^C(\mathbf{y},\boldsymbol{\pi};\mu) \geq W_C^C(\mathbf{y}',\boldsymbol{\pi};\mu)$, for all values of μ.

Consider couples of the Identical Shape Harmonic Absolute Risk Aversion (ISHARA) type. These are couples for which both spouses have HARA utilities with identical "shape" coefficients. HARA Utility exhibits an absolute risk aversion which is an harmonic function of income, i.e., for individual A:

$$-\frac{V_A^{A''}(x)}{V_A^{A'}(x)} = \frac{1}{\gamma_A x + c_A}, \quad x > 0.$$

When $\gamma_A = 0$, HARA corresponds to the CARA utility with a coefficient of absolute risk aversion equal to c_A. When $\gamma_A = 1$, this is a generalization of the logarithmic utility $V_A(x) = \ln(x + c_A)$. When $c_A = 0$, this is the CRRA utility. For $\gamma_A \neq 0$ and $\gamma_A \neq 1$, utilities of the HARA type take the form

$$V_A^A(x) = \frac{(c_A + \gamma_A x)^{1-1/\gamma_A}}{1 - 1/\gamma_A},$$

where γ_A is the shape coefficient. ISHARA means that man M and woman F have identical shape coefficients (i.e., $\gamma_F = \gamma_M$), meaning that CARA utilities always belong to the ISHARA class, while CRRA utilities belong to the ISHARA class only when individuals have identical preferences.

Mazzocco (2007) shows that an ISHARA couple is a necessary and sufficient condition for a couple utility function that is independent of the bargaining powers exists.

Proposition 1 (Mazzocco, 2007, Proposition 1) *Assume that spouses are risk-averse, are nonaltruistic and perfectly know each other. Under* ex ante *efficiency, the couple can be represented using a unique utility function which is independent of the bargaining powers if and only if*

[5] *Ex ante* efficiency requires first that the allocation of consumption is efficient in each state s, (i.e., no other allocation could improve both utilities at the same cost), and second that the allocation of couple resources across states is efficient (i.e., no state-contingent exchange can improve both agents' expected utilities). *Ex post* efficiency imposes no restrictions on behavior across states. *Ex ante* efficiency further imposes that the bargaining power μ be constant across states, i.e., $\mu_s = \mu$ for all s, which implies that risk is shared efficiently between spouses.

the couple belongs to the ISHARA class.

However, Mazzocco (2007)'s aggregation relies on assumptions that we may want to relax. In the remainder of this section, we show how relaxing some of them may cause this result to fail, thereby justifying our experimental-based approach.

3.2 Extension to Altruism

3.2.1 Setting: Perfectly Informed Altruistic Spouses

Assume that both spouses F and M are risk averse, are altruistic and perfectly know each other. Each perfectly informed altruistic spouse $A \in \{F, M\}$ is characterised by individual preferences with corresponding indirect utility function V_C^A and is an expected utility maximiser. Each individual in the couple is altruistic in the sense that s/he understands and takes into account the consequences of his/her choice on his/her spouse.

When perfectly informed, the altruistic woman F is better off when the actual utility of her spouse M (i.e., evaluated with her spouse M's preferences) is larger. Then, following the prevailing literature (see e.g., Browning et al., 2014), her expected utility is given by:

$$W_C^F\left(\mathbf{x}, \mathbf{y}, \boldsymbol{\pi}; \overline{\delta}_F\right) \equiv \sum_{s=1}^{S} \pi_s V_C^F\left(x_s, y_s\right) = \left(1 - \overline{\delta}_F\right) W_F^F\left(\mathbf{x}, \boldsymbol{\pi}\right) + \overline{\delta}_F W_M^M\left(\mathbf{y} - \mathbf{x}, \boldsymbol{\pi}\right), \quad (3)$$

$$= \sum_{s=1}^{S} \pi_s \left[\left(1 - \overline{\delta}_F\right) V_F^F\left(x_s\right) + \overline{\delta}_F V_M^M\left(y_s - x_s\right)\right], \quad (4)$$

where $\overline{\delta}_F$ is the degree of perfectly informed altruism of woman F towards man M.[6] When $\overline{\delta}_F = 0$, W_C^F coincides with W_F^F, meaning that woman F is egoistic (zero altruism). In contrast, when $\overline{\delta}_F = 1$, W_C^F coincides with W_M^M, meaning that she is fully altruistic. When $\overline{\delta}_F < 0$, woman F is said to be malevolent and when $\overline{\delta}_F > 1$, s/he overracts.[7]

Similarly, the perfectly informed altruistic man M's expected utility is given by:

$$W_C^M\left(\mathbf{x}, \mathbf{y}, \boldsymbol{\pi}; \overline{\delta}_M\right) \equiv \sum_{s=1}^{S} \pi_s V_C^M\left(x_s, y_s\right) = \left(1 - \overline{\delta}_M\right) W_M^M\left(\mathbf{y} - \mathbf{x}, \boldsymbol{\pi}\right) + \overline{\delta}_M W_F^F\left(\mathbf{x}, \boldsymbol{\pi}\right), \quad (5)$$

$$= \sum_{s=1}^{S} \pi_s \left[\left(1 - \overline{\delta}_M\right) V_M^M\left(y_s - x_s\right) + \overline{\delta}_M V_F^F\left(x_s\right)\right], \quad (6)$$

where $\overline{\delta}_M$ is the degree of perfectly informed altruism of man M towards woman F.

Consider now couple C as a single decision-maker. The decision made by couple C (i.e., jointly by both spouses F and M) is a combination of the decisions made separately by spouses F and

[6] See Appendix B for more details.

[7] $\overline{\delta}_F < 0$ when, compared to her egoistic preferences, what she decides with couple money goes in the direction opposite to the one corresponding to the actual preferences of her spouse. This might be either because she disapproves so much the preferences of her spouse that she wants to over-compensate the difference with her own preferences, or because she has a bad evaluation of her spouse's preferences (see the next subsection).

M for the couple, where the weights of the combination reflect the spouses' relative bargaining powers. Then, couple C's expected utility is given by:

$$W_C^C(\mathbf{y}, \boldsymbol{\pi}; \mu) \equiv \textstyle\sum_{s=1}^S \pi_s V_C^C(y_s) = \mu W_C^F(\mathbf{y}, \boldsymbol{\pi}) + (1-\mu) W_C^M(\mathbf{y}, \boldsymbol{\pi}), \tag{7}$$

$$= \sum_{s=1}^S \pi_s \left[\mu V_C^F(x_s) + (1-\mu) V_C^M(y_s - x_s)\right], \tag{8}$$

where μ and $(1-\mu)$ are woman F and man M's bargaining powers, respectively. When $\mu \in (0,1)$, the decision made by couple C is a convex combination of the decisions made separately by the spouses within the couple. When $\mu = 1$, W_C^C coincides with W_C^F, that is, couple C and woman F decide for the couple in the same way, meaning that woman F has full power. In contrast, when $\mu = 0$, W_C^C coincide with W_C^M and man M has full power power. $\mu < 0$ corresponds to a power abuse of man M and $\mu > 1$ corresponds to a power abuse of woman F.

3.2.2 Aggregation

Combining Equations (3), (5) and (7), couple C's expected utility can be rewritten in terms of individual nonaltruistic expected utilities, W_F^F and W_M^M (or equivalently, combining Equations (4), (6) and (8), in terms of individual nonaltruistic utilities V_F^F and V_M^M) as follows:

$$W_C^C(\mathbf{y}, \boldsymbol{\pi}; \tilde{\mu}) = \tilde{\mu} \sum_{s=1}^S \pi_s V_F^F(x_s) + (1-\tilde{\mu}) \sum_{s=1}^S \pi_s V_M^M(y_s - x_s), \tag{9}$$

$$= \tilde{\mu} W_F^F(\mathbf{x}, \boldsymbol{\pi}) + (1-\tilde{\mu}) W_M^M(\mathbf{y} - \mathbf{x}, \boldsymbol{\pi}), \tag{10}$$

where $\tilde{\mu} = \mu(1-\delta_F) + (1-\mu)\delta_M$.

When spouses are possibly altruistic and perfectly know each other, couple C's expected utility, given by Equation (10), is formally identical to the expected utility when both spouses are egoistic, given by Equation (1). An increase in woman F's altruism towards man M can be actually thought as an increase in man M's bargaining power (i.e., an increase in altruism provides the spouses with a greater bargaining power with respect to egoistic preferences). Altruism thus modifies the risk-sharing within couples, but has no effect on the level of risk-taking, meaning that Mazzocco (2007)'s aggregation result still holds when spouses are possibly altruistic *and* perfectly know each other.[8]

This result, which is well-known in the Economics of family literature in the deterministic case (see Browning et al., 2014, Chapter 3.5), easily extends to the case under risk when spouses are risk-averse and perfectly know each other. It relies on the separability between woman F's sphere and man M's sphere (see e.g., Chiappori, 1992, for more details): couple C's expected utility is indeed separable in individual consumptions x_s and $y_s - x_s$ (in the sense that woman F's consumptions are evaluated only through the lens of her own preferences, and similarly for man

[8] The case when only one spouse is altruistic is a special case.

M).

We summarise this result as follows.

Proposition 2 *Assume that spouses risk-averse, are altruistic, and perfectly know each other. Then, Proposition 1 still holds.*

3.3 Extension to Imperfect Knowledge

3.3.1 Setting: Imperfectly Informed Altruistic Spouses

Assume that both spouses F and M are risk averse, are altruistic, but do not perfectly know each other. Each imperfectly informed altruistic spouse $A \in \{F, M\}$ is characterised by individual preferences with corresponding indirect utility function V_C^A and is an expected utility maximiser.

Woman F, who does not perfectly know the preferences of her spouse M, uses her own preferences as reference point to conjecture his preferences. Then, man M's expected utility as perceived by woman F is given by:

$$W_M^F(\mathbf{y}-\mathbf{x}, \boldsymbol{\pi}; \xi_F) = (1-\xi_F) W_F^F(\mathbf{y}-\mathbf{x}, \boldsymbol{\pi}) + \xi_F W_M^M(\mathbf{y}-\mathbf{x}, \boldsymbol{\pi}), \tag{11}$$

$$= \sum_{s=1}^{S} \pi_s \left[(1-\xi_F) V_F^F(y_s - x_s) + \xi_F V_M^M(y_s - x_s)\right], \tag{12}$$

where ξ_F is the degree of empathy of woman F towards man M. Empathy refers to the ability to understand and share the feelings of another: the closer to man M's actual preferences (W_M^M) is woman F's conjecture about man M's preferences (W_M^F), the more woman F is empathic. When $\xi_F = 0$, W_M^F coincides with W_F^F, meaning that woman F has zero empathy towards her spouse M. In contrast, when $\xi_F = 0$, W_M^F coincides W_M^M, meaning that she is fully empathic. When $\xi_F < 0$,woman F is said to be malevolent and when $\xi_F > 1$, she overracts.[9]

When imperfectly informed, the altruistic woman F is better off when the utility of her spouse M as perceived by herself (i.e., with her guess about man M's preferences) is larger. Then, her expected utility is given by:

$$W_C^F(\mathbf{x}, \mathbf{y}, \boldsymbol{\pi}; \delta_F) \equiv \textstyle\sum_{s=1}^{S} \pi_s V_C^F(x_s, y_s) = (1-\delta_F) W_F^F(\mathbf{x}, \boldsymbol{\pi}) + \delta_F W_M^F(\mathbf{y}-\mathbf{x}, \boldsymbol{\pi}), \tag{13}$$

$$= \sum_{s=1}^{S} \pi_s \left[(1-\delta_F) V_F^F(x_s) + \delta_F V_M^F(y_s - x_s)\right], \tag{14}$$

[9] $\xi_F < 0$ means that woman F overweights the difference between her own preferences and her spouse's preferences. There are two cases. In the first case, the overweight is towards herself. This might be because she disapproves this difference in preferences and she is willing so much to make her spouse's preferences closer to her own preferences that she overcompensates the divergence in preferences. In the second case, the overweight is towards her spouse. This might be because she wants to make it really clear that she knows and takes into account the preferences of her spouse that she overreacts to this divergence.

where δ_F is the degree of imperfectly informed altruism of woman F towards man M. When $\delta_F = 0$ (zero altruism), woman F is egoistic and, when $\delta_F = 1$, she is fully altruistic. When $\delta_F < 0$, woman F is said to be malevolent and when $\delta_F > 1$, she overracts.[10]

Similarly, woman F's expected utility as perceived by man M is given by

$$W_F^M(\mathbf{x}, \boldsymbol{\pi}; \xi_M) = (1 - \xi_M) W_M^M(\mathbf{x}, \boldsymbol{\pi}) + \xi_M W_F^F(\mathbf{x}, \boldsymbol{\pi}), \tag{15}$$

$$= \sum_{s=1}^{S} \pi_s \left[(1 - \xi_M) V_M^M(x_s) + \xi_M V_F^F(x_s)\right], \tag{16}$$

where ξ_M is the degree of empathy of man M towards woman F. The imperfectly informed altruistic man M's expected utility is given by:

$$W_C^M(\mathbf{x}, \mathbf{y}, \boldsymbol{\pi}; \delta_M) \equiv \textstyle\sum_{s=1}^{S} \pi_s V_C^M(x_s, y_s) = (1 - \delta_M) W_M^M(\mathbf{y} - \mathbf{x}, \boldsymbol{\pi}) + \delta_M W_F^M(\mathbf{x}, \boldsymbol{\pi}), \tag{17}$$

$$= \sum_{s=1}^{S} \pi_s \left[(1 - \delta_M) V_M^M(y_s - x_s) + \delta_M V_F^M(x_s)\right] \tag{18}$$

where δ_M is the degree of imperfectly informed altruism of man M towards woman F.

3.3.2 Aggregation

Combining Equations (10), (11), (15), (13) and (17), couple C's expected utility can be rewritten in terms of individual nonaltruistic utilities W_F^F and W_M^M (or equivalently in terms of individual nonaltruistic utilities V_F^F and V_M^M) as follows:

$$\begin{aligned} W_C^C(\mathbf{y}, \boldsymbol{\pi}; \mu, \xi_F, \xi_M, \delta_F, \delta_M) = {} & [\mu(1 - \delta_F) + (1 - \mu)\delta_M \xi_M] W_F^F(\mathbf{x}, \boldsymbol{\pi}) \\ & + \mu \delta_F (1 - \xi_F) W_F^F(\mathbf{y} - \mathbf{x}, \boldsymbol{\pi}) \\ & + [(1 - \mu)(1 - \delta_M) + \mu \delta_F \xi_F] W_M^M(\mathbf{y} - \mathbf{x}, \boldsymbol{\pi}) \\ & + (1 - \mu)\delta_M (1 - \xi_M) W_M^M(\mathbf{y} - \mathbf{x}, \boldsymbol{\pi}), \end{aligned} \tag{19}$$

$$\begin{aligned} = {} & \sum_{s=1}^{S} \pi_s \{[\mu(1 - \delta_F) + (1 - \mu)\delta_M \xi_M] V_F^F(x_s) \\ & + \mu \delta_F (1 - \xi_F) V_F^F(y_s - x_s) \\ & + [(1 - \mu)(1 - \delta_M) + \mu \delta_F \xi_F] V_M^M(y_s - x_s) \\ & + (1 - \mu)\delta_M (1 - \xi_M) V_M^M(x_s)\}. \end{aligned} \tag{20}$$

When spouses are possibly altruistic and do not perfectly know each other, couple C's expected utility, given by Equation (19), is no more formally identical to the expected utility when both

[10] $\delta_F < 0$ when woman F is willing so much to impose her preferences to her spouse that, compared to her egoistic preferences, what she decides with couple money goes in the direction opposite to the one corresponding to what she states the preferences of her spouse are.

spouses are egoistic, given by Equation (1). This is because, there is no more separability between woman F's sphere and man M's sphere (i.e., woman F and man M's consumptions are evaluated both through the lens of both woman F's utility and man M's utility, V_M^M).

In this case, an increase in woman F's altruism towards man M cannot be thought anymore as an increase in man M's bargaining power. Altruism modifies both the risk-sharing within couples and the level of risk-taking, meaning that Mazzocco (2007)'s aggregation result does not hold when spouses are altruistic *and* do not perfectly know each other.

To show this, assume that utilities $V_A^B \in \{V_F^F, V_M^M, V_M^F, V_F^M, V_C^F, V_C^M, V_C^C\}$ are of the CARA type, i.e.,

$$V_A^B(x) = V\left(x; \theta_a^B\right) = \frac{1 - \exp(-\theta_a^B x)}{\theta_a^B}, \quad x > 0, \tag{21}$$

where θ_a^B is the corresponding level of absolute risk aversion. θ_f^F (resp., θ_m^M) is the coefficient of risk aversion of woman F (resp., man M); θ_c^C is the coefficient of risk aversion of couple C; θ_f^M (resp., θ_m^F) is the coefficient of risk aversion of woman F as guessed by man M (resp., man M as guessed by woman F); θ_c^F (resp., θ_c^M) is the coefficient of risk aversion of woman F (resp., man M) deciding for couple C.

Then, consider the following example.

Example 3 *Let couple C face two income profiles $\mathbf{y}$ and $\mathbf{y}'$ with $\mathbf{y} = (2, 1/4; 10, 3/4)$ and $\mathbf{y}' = (4, 1/4; 4, 3/4)$. Spouses are altruistic with $\delta_F = 0.7$ and $\delta_M = 0.5$.*

1. *Spouse do not perfectly know each other with $\theta_f^M = 1.5 \neq \theta_f^F = 3$ and $\theta_m^F = 1.25 \neq \theta_m^M = 1$. Then, couple C prefers $\mathbf{y}$ over $\mathbf{y}'$ for $\mu < 0.67$ and prefers y' over y for $\mu > 0.67$.*

2. *Only the woman perfectly knows the preferences of her spouse with $\theta_f^M = 1.5 \neq \theta_f^F = 3$ and $\theta_m^F = \theta_m^M = 1$. Then, couple C prefers $\mathbf{y}$ over $\mathbf{y}'$ for $\mu < 0.88$ and prefers y' over y for $\mu > 0.88$.*

3. *Spouse do not perfectly know each other with $\theta_f^M = 1.5 \neq \theta_f^F = 2$ and $\theta_m^F = 1.25 \neq \theta_m^M = 1$. Then, couple C prefers $\mathbf{y}'$ over $\mathbf{y}$ for all μ.*

4. *Only the woman perfectly knows the preferences of her spouse with $\theta_f^M = 1.5 \neq \theta_f^F = 2$ and $\theta_m^F = \theta_m^M = 1$. Then, couple C prefers $\mathbf{y}'$ over $\mathbf{y}$ for all μ.*

In the first two cases, couple C's preferences over income profiles depend on spouses' bargaining powers, and, in the last two cases, they do not.

We summarise this result as follows.

Proposition 4 *Proposition 1 fails to hold if at least one individual within the couple is altruistic* and *does not perfectly know the preferences of his/her spouse.*

When Mazzocco (2007)'s aggregation result fails to hold, this means that the couple cannot be represented by a utility function which is independent of the degrees of empathy and altruism and of the bargaining powers. In other words, this means that it is not sufficient to measure woman F and man M's preferences to predict couple C risk-taking. Instead, we also need to measure the degrees of empathy and altruism as well as the bargaining powers, even in cases in which we are interested in the risk-taking and not in the risk-sharing of the couple.

4 Empirical Strategy

We have just shown that Mazzocco (2007)'s aggregation result may fail to hold when we extend his setting to altruism with imperfect knowledge. This implies that we cannot rely on existing theoretical aggregation results and, in turn, justifies our experimental-based analysis.

In addition, since there is no closed form formulae describing the risk-taking of the couple, we cannot recover the degrees of empathy, of altruism and the bargaining powers defined in the previous section. We then propose a reduced form approach which is intended to approximate the couple behavior (i.e., we assume that the couple behaves as if it maximises a utility function). Specifically, we propose local approximations or measures of empathy, altruism and bargaining powers, which we build as distances between levels of risk aversion. To do so, we need to assume a functional form for the utilities. Following de Palma et al. (2010), we choose the CRRA specification over the CARA specification.[11] Utilities $V_A^B \in \{V_F^F, V_M^M, V_M^F, V_F^M, V_C^F, V_C^M, V_C^C\}$ are then given by:

$$V_A^B(x) = V\left(x; \theta_a^B\right) = \frac{x^{1-\theta_a^B}}{1-\theta_a^B}, \quad x > 0, \quad \theta_a^B \neq 1, \tag{22}$$

with $V(x;1) = \ln(x)$, where θ_a^B is the corresponding level of relative risk aversion. In our empirical setting, θ_a^B refers to as the level of risk aversion when individual A answers the question and individual B's money is involved.

4.1 Computation of Levels of Risk Aversion.

In each investment series $j = 1, ..., 9$, each individual/couple faces 11 choices $i = 1...11$ between a lottery L_j and a sure payoff $S_j(i)$. The lottery yields the low payoff $S_j(11)$ and the high payoff $S_j(1)$ with equal probabilities and the sequence of sure payoffs is given by $S_j(i) = S_j(11) + \left(\frac{11-i}{10}\right)(S_j(1) - S_j(11))$, $i = 1...11$. For each investment series j, the expected value of the lottery equals $S_j(6)$, so that a risk-neutral individual is indifferent between the lottery and $S_j(6)$.

To elicit preferences, we employ a choice bracketing procedure (see e.g., de Palma et al., 2011). Combined with the CRRA specification, this procedure allows to obtain intervals for the levels

[11] In that paper, the authors propose a method to test functional form, which is robust to probability deformation but not to loss aversion. They find that we cannot reject the CRRA specification when subjects experience no loss.

of risk aversion. Indeed, the set of choices made by an individual/couple in investment series j is inconsistent if monotonic and transitive preference cannot rationalise those choices. Therefore, a consistent set of choices is characterised by a unique switching point, $i \in \{1, \ldots, 11\}$: for a given investment series j, an individual/couple with a switching point i prefers lottery L_j to all deterministic amounts lower than or equal to $S_j(i+1)$ and prefers all amounts larger than or equal to $S_j(i)$ to lottery L_j. Then, given the construction of the series, switching points i define intervals for the CRRA coefficients of risk aversion: in series j, an individual/couple n facing lottery l and with switching point i has a coefficient of risk aversion $\theta(j,l)$ that belongs to the interval $[\underline{\theta}(j), \overline{\theta}(j)]$. Note that for inconsistent individuals (i.e., those with multiple switching points), we use the larger interval that can rationalise these choices.

To compute the levels of risk aversion of each individual n facing lottery l in series j, $\theta_n(j,l)$, we employ an interval regression model, first proposed by Coller & Williams (1999) in the context of an MPL. Specifically, we estimate a random-effects interval regression model, in which the observed left-hand side is the interval for risk aversion. That is, we model coefficients of risk aversion $\theta_n(j,l)$ by the following linear regression model with random effects:

$$\theta_n(j,l) = \mathbf{x}_{njl}\boldsymbol{\beta} + \sigma_\nu \nu_n + \sigma_\varepsilon \epsilon_{nj}, \tag{23}$$

where $\mathbf{x}_{njl}$ include individual n's characteristics (e.g., gender) as well as series- and lottery-specific dummies, and where the random effects ν_n are i.i.d. $\mathcal{N}(0,1)$ and ϵ_{nj} are i.i.d. $\mathcal{N}(0,1)$ independently of ν_n. We run interval regressions over series 3 by 3 (i.e., step by step).

The individual- and series-specific levels of risk aversion are then computed as the expected value of $\theta_n(j,l)$ conditional on $\theta_n(j,l) \in \left[\underline{\theta}_n(j); \overline{\theta}_n(j)\right]$:

$$\theta_n(j,l) = \mathbb{E}\left[\theta_n(j,l) \left| \underline{\theta}_n(j,l) < \theta_n(j) < \overline{\theta}_n(j)\right.\right]. \tag{24}$$

These are local measures of the individual-specific levels of risk aversion θ_n. Therefore, we compute individual-specific levels of risk aversion, θ_n, by aggregating the individuals and series-specific levels $\theta_n(j,l)$'s over series 3 by 3 (i.e., step by step). Specifically, they are obtained as the weighted average of the levels of individual- and series-specific levels of risk aversion, where the weights are chosen so as to minimise the variance of the weighted average in the sample (see Appendix D for more details).

4.1.1 Definitions: Empathy, Altruism and Bargaining Powers

Figure 1 summarises how the experimental protocol presented in Section 2 allows us to determine how, starting from individual levels of risk aversion, θ_f^F and θ_m^M, altruism and bargaining powers lead to couple level of risk aversion θ_c^C.

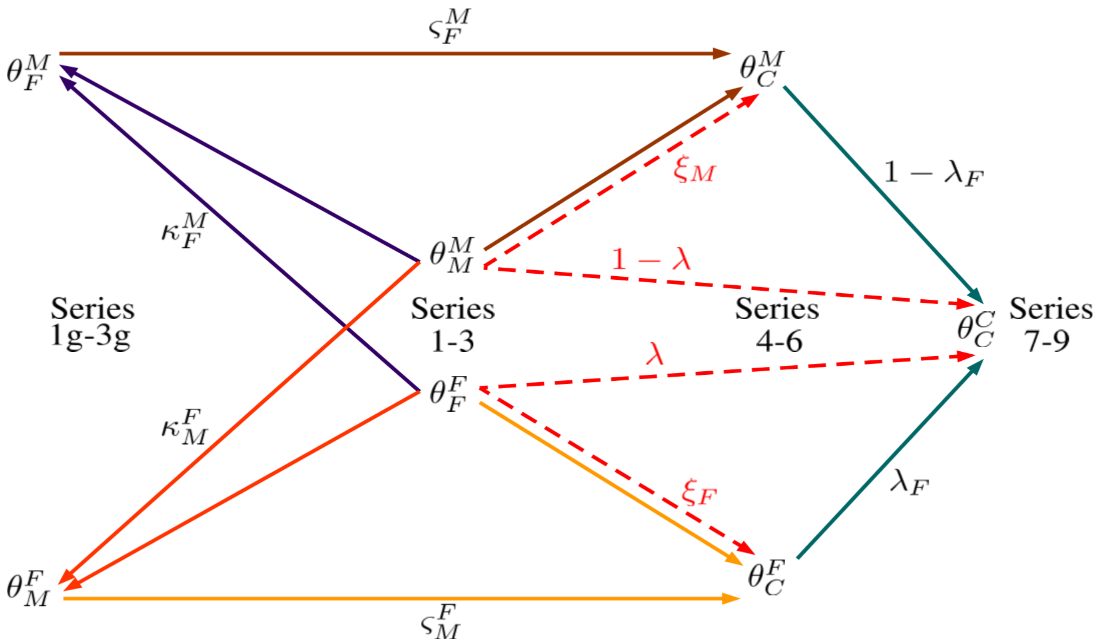

Figure 1: From Individual Preferences to Couple Decisions

Empathy Series $1-3$ are used to elicit the levels of risk aversion of woman F and man M, denoted by θ_f^F and θ_m^M, respectively. Series $1g-3g$ are used to elicit the levels of risk aversion of man M as guessed by woman F and of woman F as guessed by man M, denoted by θ_m^F and θ_f^M, respectively.

Assume that woman F (resp., man M) does not perfectly know the level of risk aversion of her spouse M (resp., his spouse F) and thus states an imperfect guess. This guess then reflects how woman F (resp., man M) thinks that her spouse M (resp., his spouse F) behaves or answers and is influenced by her own level of risk aversion, which acts as a reference point.

Woman F (resp. man M) thus has some degree of empathy, in the sense that the more empathic she is, the more accurate her guess is. We measure the degree of empathy of woman F towards man M by the distance between θ_m^F and θ_f^F as follows:

$$\kappa_M^F = \frac{\theta_m^F - \theta_f^F}{\theta_m^M - \theta_f^F}, \quad \theta_f^F \neq \theta_m^M. \tag{25}$$

We symmetrically measure the degree of empathy of man M towards woman F, κ_F^M.

Empathy is relevant only when woman F and man M have different levels of risk aversion, i.e., when $\theta_f^F \neq \theta_m^M$. Otherwise, we cannot distinguish how much the guess θ_m^F is influenced by θ_f^F and by θ_m^M, respectively. $\kappa_M^F = 0$ arises when woman F states that her spouse M's level of risk aversion is exactly equal to her own level of risk aversion and $\kappa_M^F = 1$ when F perfectly states M's level of risk aversion. $\kappa_M^F \in (0,1)$ corresponds to the convex case in which θ_m^F lies between θ_f^F and θ_m^M, meaning that F imperfectly states M's level of risk aversion and uses her own as a reference point.

Perfectly informed altruism Consider that woman F and man M are possibly altruistic; and assume that woman F (resp., man M) perfectly knows the level of risk aversion of her spouse M (resp., his spouse F).

The choice of woman F (resp., man M) who invests couple's money thus depends both on her (resp., his) own level of risk aversion and on her spouse M (resp., his spouse F) (actual) level of risk aversion.

Series $4-6$ are used to elicit the levels of risk aversion of woman F investing alone for couple C and of man M investing alone for couple C, denoted by θ_c^F and θ_c^M, respectively. We measure the degree of perfectly informed altruism of woman F towards man M by the distance between θ_c^F and θ_f^F as follows:

$$\xi_M^F = \frac{\theta_C^f - \theta_f^F}{\theta_m^M - \theta_f^F}, \quad \theta_f^F \neq \theta_m^M. \tag{26}$$

We symmetrically measure the degree of perfectly informed altruism of man M towards woman F, ξ_F^M.

Altruism is relevant only when woman F and man M have different levels of risk aversion, i.e., when $\theta_f^F \neq \theta_m^M$. $\xi_M^F = 0$ corresponds to an egoistic woman F (i.e., a woman who behaves exactly in the same way when deciding for the couple with consequences on her spouse and when deciding for herself without any consequence for her spouse) and $\xi_M^F = 1$ corresponds to a woman F whose choice only depends on her spouse's level of risk aversion (i.e., when $\theta_c^F = \theta_m^M$).

Imperfectly informed altruism Assume that woman F (resp., man M) does not perfectly know the level of risk aversion of her spouse M (resp., his spouse F). The choice of woman F (resp., man M) who invests couple's money thus depends both on her (resp., his) own level of risk aversion and on her (resp., his) guess about her (resp., his) spouse's level of risk aversion. We measure the degree of imperfectly informed altruism of woman F towards man M by the distance between θ_c^F and θ_m^F as follows:

$$\varsigma_M^F = \frac{\theta_c^F - \theta_f^F}{\theta_m^F - \theta_m^F}, \quad \theta_m^F \neq \theta_f^F. \tag{27}$$

We symmetrically measure the degree of imperfectly informed altruism of man M towards woman F, ς_F^M. $\varsigma_M^F = 0$ corresponds to an egoistic woman F and $\varsigma_M^F = 1$ to a woman F whose choice only depends on her guess about her spouse's level of risk aversion (i.e., when $\theta_c^F = \theta_m^F$).

Bargaining power The decision made by the couple depends on the decisions made by each spouse in the same context and on their respective bargaining powers. Series $7-9$ are used to elicit the level of risk aversion of couple C, denoted by θ_c^C. We measure the bargaining power of woman F relative to man M by the distance between θ_c^C and θ_c^F as follows:

$$\lambda_F = \frac{\theta_c^C - \theta_c^F}{\theta_c^F - \theta_c^M}, \quad \theta_c^F \neq \theta_c^M. \tag{28}$$

We symmetrically measure the bargaining power of man M relative to woman F, λ_M.

Bargaining power is relevant only when woman F and man M behave differently when investing alone for couple C, i.e., when $\theta_c^F \neq \theta_c^M$. $\lambda_F = 1$ corresponds to the case in which woman F has full power (i.e., when $\theta_c^C = \theta_c^F$) and $\lambda_F = 0$ to the case in which man M has full power (i.e., when $\theta_c^C = \theta_c^M$).

4.1.2 Aggregation of preferences

We are interested in measuring the true (i.e., unbiased) degrees of altruism and bargaining power. Ignoring that spouses are possibly altruistic and may not perfectly knoweach other leads to bias these degrees.

To see this, let woman F's level of risk aversion investing alone for couple C be given by

$$\theta_c^F = \xi_F \theta_m^M + (1 - \xi_F)\,\theta_f^F, \tag{29}$$

where ξ_F is the biased altruism of woman F towards man M. When woman F is nonaltruistic, then $\xi_F = 0$. Assume instead that she is altruistic. When she perfectly knows her spouse F, then the biased and true altruism coincide, that is, $\xi = \xi_F^F$. Conversely, when she does not perfectly know him, then the biased altruism (ξ_F) and true altruism (ς_M^F) do not coincide anymore, since $\xi_F = \varsigma_M^F \kappa_M^F$.

Then, when $\kappa_M^F \in (0,1)$, then $\varsigma_M^F > \xi_M^F$, meaning that incorrectly assuming that woman F perfectly knows her spouse M leads to underestimate the altruism of woman F towards man M.

Turn now to spouses's bargaining power and let couple C's level of risk aversion be given by

$$\theta_c^C = \lambda \theta_f^F + (1 - \lambda)\,\theta_m^M, \tag{30}$$

where λ denotes the biased bargaining power of woman F relative to man M, to be distinguished from λ_F, the true bargaining power of woman F relative to man M.

When spouses are nonaltruistic and perfectly know each other, then they behave exactly in the same way when investing for couple C and for themselves (i.e. $\theta_c^F = \theta_f^F$ and $\theta_c^M = \theta_m^M$). In this case, the biased and true bargaining powers coincide, that is, $\lambda = \lambda_F$ (see Equation (28)).

Assuming instead that spouses are altruistic, the biased and true bargaining powers do not coincide anymore. When they perfectly know each other, combining Equations (26) and (28), the biased bargaining power is given by

$$\lambda = \hat{\lambda} \equiv \xi_M^M + \lambda_F \left(1 - \xi_M^M - \xi_F^F\right) = \lambda_F - \lambda_F \xi_F^F + (1 - \lambda_F)\, \xi_M^M, \tag{31}$$

and when they do not perfectly know each other, combining Equations (27) and (28), it is given by

$$\lambda = \tilde{\lambda} \equiv \lambda_F - \lambda_F \kappa_M^F \varsigma_F^F + (1 - \lambda_F)\, \kappa_F^M \varsigma_M^M. \tag{32}$$

The biased bargaining powers $\tilde{\lambda}$ and $\hat{\lambda}$ have three components. The first component is the true bargaining power λ_F. The other two components comes from altruism and capture the mechanism mentioned above that an increase in woman F's (resp., man M's) altruism towards man M (resp., woman F) can be thought as an increase in man M's (resp., woman F's) bargaining power.

Mazzocco (2007). In Mazzocco (2007), spouses are assumed to perfectly know each other (i.e., $\theta_m^F = \theta_m^M$ and $\theta_f^M = \theta_f^F$), which implies that spouses are fully empathic: $\kappa_M^F = 1$ for woman F and $\kappa_F^M = 1$ for man M. Spouses are also assumed to be nonaltruistic (i.e., $\varsigma_M^F = 0$ for woman F and $\varsigma_F^M = 0$ for woman M)

4.1.3 Econometric Models of Aggregation of Individual Preferences

There are two alternative models of aggregation of individual preferences, depending on whether spouses are assumed to perfectly know each other or not.

Assume first that they perfectly know each other. Then, using Equations (26) and (28), aggregation of individual preferences are described by the following three equations:

$$\begin{aligned} \theta_c^F &= a_{FM}\theta_m^M + a_{FF}\theta_f^F + \epsilon_{FC}, \\ \theta_c^M &= a_{MF}\theta_f^F + a_{MM}\theta_m^M + \epsilon_{MC}, \\ \theta_c^C &= w_F\theta_c^F + w_M\theta_c^M + \epsilon_{CC}, \end{aligned}$$

where ϵ_{MC}, ϵ_{FC}, and ϵ_{CC} are the econometric error terms of the model. The first two equations describe woman F's and man M's attitudes when investing for couple C, respectively. They allow us to estimate the imperfectly informed altruism of woman F towards man M (a_{FM}) as well as of man M towards woman F (a_{MF}). The third one describes couple C's attitude when investing its own money and allows us to estimate the bargaining powers of woman F (w_F) and man M (w_M).

It is worth noting that that the degrees of empathy, altruism and bargaining powers defined in the previous subsection are individual/couple-level, but that we estimate them at the population-level. Residuals capture individuals/couples heterogeneity in the degrees of altruism and bargaining powers and/or measurement error.

Assume now that spouses do not perfectly know each other. Then, using Equations (25) (27) and (28), aggregation of individual preferences are described by the following five equations:

$$
\begin{aligned}
\theta_c^F &= a_{FM}\theta_m^F + a_{FF}\theta_f^F + \epsilon_{FC}, \\
\theta_c^M &= a_{MF}\theta_f^M + a_{MM}\theta_m^M + \epsilon_{MC}, \\
\theta_c^C &= w_F\theta_c^F + w_M\theta_c^M + \epsilon_{CC}, \\
\theta_f^M &= e_{MF}\theta_f^F + e_{MM}\theta_m^M + \epsilon_{MF}, \\
\theta_m^F &= e_{FM}\theta_m^M + e_{FF}\theta_f^F + \epsilon_{FM},
\end{aligned}
$$

where ϵ_{MF}, ϵ_{MC}, ϵ_{FM}, ϵ_{FC}, and ϵ_{CC} are the econometric error terms of the model. The first three equations are similar to the ones in the previous model, except that in the first two equations the actual spouse's levels of risk aversion have been replaced with the guessed levels of spouse's risk aversion to reflect that spouses do not perfectly know each other. They allow us to estimate the imperfectly altruism of woman F towards man M (a_{FM}) and of man M towards woman F (a_{MF}) as well as the bargaining powers of woman F (w_F) and man M (w_M). The last two equations describe woman F's and man M's guessing the levels of risk aversion of their spouse and allow us to estimate the empathy of man M towards woman F (e_{MF}) as well as of woman F towards man M (e_{FM}).

5 Empirical Results

5.1 Computation of Individual-Specific Levels of Risk Aversion

Tests of Specifications The goal of the tests below is, starting from the most general specifications, to select the most parcimonious specifications that will be used to compute the individual-specific levels of risk aversion. For all the tests of specifications, we use the likelihood-ratio (LR) test. Consider the most general specification:

$$
\begin{aligned}
\theta_n(j,l) = \quad & \delta + \delta_F 1_{\{n=F\}} + \sum_{k=1}^{2}\left[\delta_{kM}1_{\{n=M,j=k\}} + \delta_{kF}1_{\{n=F,j=k\}}\right] + \sum_{s=1}^{5}\delta_l 1_{\{l=s\}} \\
& + \left[\beta_M 1_{\{n=M\}} + \beta_F 1_{\{n=F\}}\right] \times \text{partnership duration}_n \\
& + \left[\gamma_M 1_{\{n=M\}} + \gamma_F 1_{\{n=F\}}\right] \times \text{age}_n + \sigma_\nu \nu_n + \sigma_\varepsilon \epsilon_{nj},
\end{aligned} \tag{33}
$$

where age_n and partnership duration_n are the age and the union duration in years of individual n, respectively.[12]

We first test whether lotteries have different significant effects on the level of risk aversion, that is, the null hypothesis $H_0 : \forall l = 1,\ldots,5,\ \delta_l = 0$ against the alternative hypothesis $H_1 : \exists l =$

[12] To be precise, the variable age_n corresponds to $(\text{age} - 40)/10$, where 40 is approximately the average age of the individuals of the experiment.

$1, \ldots, 5,\ \delta_l \neq 0$.[13] LR tests lead us to reject the null hypothesis for the steps involving series $1-3$ and series $4-6$, and to not reject it for the steps involving series $7-9$ and series $1g-3g$. In addition, for all the steps, the coefficients δ_2 to δ_5 are null, which, for parcimony and consistency across specifications of different steps, leads us to replace $\sum_{s=1}^{5} \delta_l 1_{\{l=s\}}$ with $\delta_1 1_{\{l=1\}}$ for all the steps.

We then test whether there exist series-specific gender differences in the levels of risk aversion, that is, the null hypothesis $H_0 : \forall k = 1,2 \quad \delta_{kM} = \delta_{kF}$ against the alternative hypothesis $H_1 : \exists k = 1,2, \quad \delta_{kM} \neq \delta_{kF}$. For all the steps, LR tests lead us to reject the null hypothesis, and, in turn, to replace $\sum_{k=1}^{2} \left[\delta_{kM} 1_{\{n=M,j=k\}} + \delta_{kF} 1_{\{n=F,j=k\}}\right]$ with $\sum_{k=1}^{2} \delta_k 1_{\{j=k\}}$).

Next, we test whether the levels risk aversion differ from one series to another, that is the null hypothesis $H_0 : \delta_1 = \delta_2 = 0$ against the alternative hypothesis $H_1 : \exists k = 1,2,\ \delta_k \neq 0$. For all the steps, LR tests leads us to reject the null hypothesis, and, in turn, to keep dummies for series. Lastly, we remove the dummy for woman from the specifications since it is not significant for all steps.

Final Specifications Table 1 shows estimates of the random-effects interval regression models for the final specifications involving series $1-3$, series $4-6$, series $7-9$ and series $1g-3g$ in columns (1), (2), (3) and (4), respectively.[14]

5.2 Descriptive Statistics

Figure 2 shows the empirical distributions of the (computed) levels of relative risk aversion in the three investment series concerned with individual money (series $1-3$ and series $1g-3g$), separately for women and men. For both women and men, the distribution is less spread for series 1 and 2 (resp., for series $1g$ and $2g$) than for series 3 (resp., for series $3g$), which may be due to the fact that while series 1 and 2 (series $1g$ and $2g$) involve losses, series 3 (resp., series $3g$) does not.[15]

Concerning series $1-3$, women and men answers cannot be directly compared since the lotteries were generated randomly and independently for the woman and for the man. However, Table 2, which shows the average levels of relative risk aversion for the women, the men and the couples by investment series as well as their differences, supports the idea that individuals answered more randomly in series 3.[16] Moreover, on average, both women and men are more risk averse in series

[13] For each step, there are 6 different lotteries and the lotteries of the second series are obtained by doubling the payoffs of the lotteries of the first series.

[14] Models (1), (2) and (4) use only 630, 650, and 638 observations, respectively, instead of 660 observations. Missing observations arise when individuals are incoherent and it is not possible to have an interval for their level of risk aversion.

[15] Investment series 1 and 2, 4 and 5, 7 and 8 involve losses in the sense that the lower payoff is lower than the initial endowment (the reward obtained at the end of Step 1). Then, investment series 3, 6, and 9 do not involve losses.

[16] The average value of risk aversions is higher and the standard deviations (of individual answers and of their differences) are larger for series 3 than for series 1 and 2.

	(1) Series 1-3	(2) Series 4-6	(3) Series 7-9	(4) Series 1g-3g
Age F	0.419	0.990	0.859	1.591
	(0.445)	(0.046)	(0.420)	(0.004)
Age M	-0.418	0.388	0.329	-0.144
	(0.436)	(0.436)	(0.669)	(0.790)
Partnership duration × Woman	0.0943	0.0565		0.0170
	(0.037)	(0.171)		(0.710)
Partnership duration × Man	0.132	0.0652		0.0715
	(0.007)	(0.140)		(0.140)
Partnership duration			0.0142	
			(0.680)	
Constant	2.796	4.109	2.687	3.136
	(0.000)	(0.000)	(0.000)	(0.000)
Series 1/4/7/1g	-2.080	-2.166	-1.544	-1.781
	(0.000)	(0.000)	(0.000)	(0.000)
Series 2/5/8/2g	-0.975	-1.471	-0.667	-1.074
	(0.007)	(0.000)	(0.029)	(0.000)
Lottery 1	-2.359	-1.812	-0.554	-0.770
	(0.000)	(0.000)	(0.175)	(0.116)
σ_u	4.028	3.640	2.539	4.174
	(0.000)	(0.000)	(0.000)	(0.000)
σ_e	3.089	3.059	1.992	2.679
	(0.000)	(0.000)	(0.000)	(0.000)
Log likelihood	-1197.040	-1300.767	-619.617	-1254.205
Observations	630	650	330	638

p-values in parentheses

Table 1: Final Specifications

3 than in series 1 and 2, which may be explained by the fact that series 3 involves losses, and, in turn, is likely to increase risk aversion.

Figure 3 shows the empirical distributions of the (computed) levels of relative risk aversion in the six investment series concerned with couple money (series $4-6$ when spouses decide alone and series $7-9$ when they decide together), separately for women, men, and couples. In all investment series, the distribution of couple choices is more concentrated than the distribution of spouse choices. Note also that, men and women answers are more heterogeneous than couples answers, which can also be seen in Table 2.

Concerning investment series 4-9, women and men are equally risk averse, and the average couple tends to be less risk averse than its average members. Indeed, even if these differences are not significant, the average level of risk aversion for couples is systematically lower than the average levels of risk aversion for both men and women. Moreover, on average, as it was the case when investing individual money, both women and men and couples are more risk averse in series 3 than in series 1 and 2.

Investment Series	Woman	Man	Couple	Differences		
				Woman – Couple	Man – Couple	Woman – Man
1	3.9000	3.8985				-0.0012
	(3.2313)	(3.0510)				(4.2556)
2	3.9850	3.76719				-0.2178
	(3.4353)	(3.4886)				(4.3703)
3	4.4126	4.4886				0.07604
	(7.0602)	(6.0997)				(8.5273)
4/7	4.4011	4.5067	3.2123	1.1888	1.2944	0.1055
	(3.3303)	(2.5230)	(1.9916)	(2.4026)	(2.4994)	(3.8425)
5/8	4.7145	4.3137	3.2518	1.4627	1.0620	-0.4008
	(3.8110)	(3.0109)	(2.5040)	(2.9056)	(2.5462)	(3.8066)
6/9	4.9395	5.0371	3.4650	1.5720	1.4745	0.0975
	(7.1955)	(5.8224)	(4.3800)	(5.4342)	(6.1907)	(8.5560)

Notes: Standard deviations in parentheses.

Table 2: Average computed risk aversions by series

5.3 From Individual Preferences to Couple Decision under Risk

5.3.1 Evidence

Section 3 highlights that empathy, altruism, and bargaining powers possibly play a role in the process starting from individual preferences to couple decisions under risk. In this subsection, we exhibit descriptive statistics that help us understanding this process.

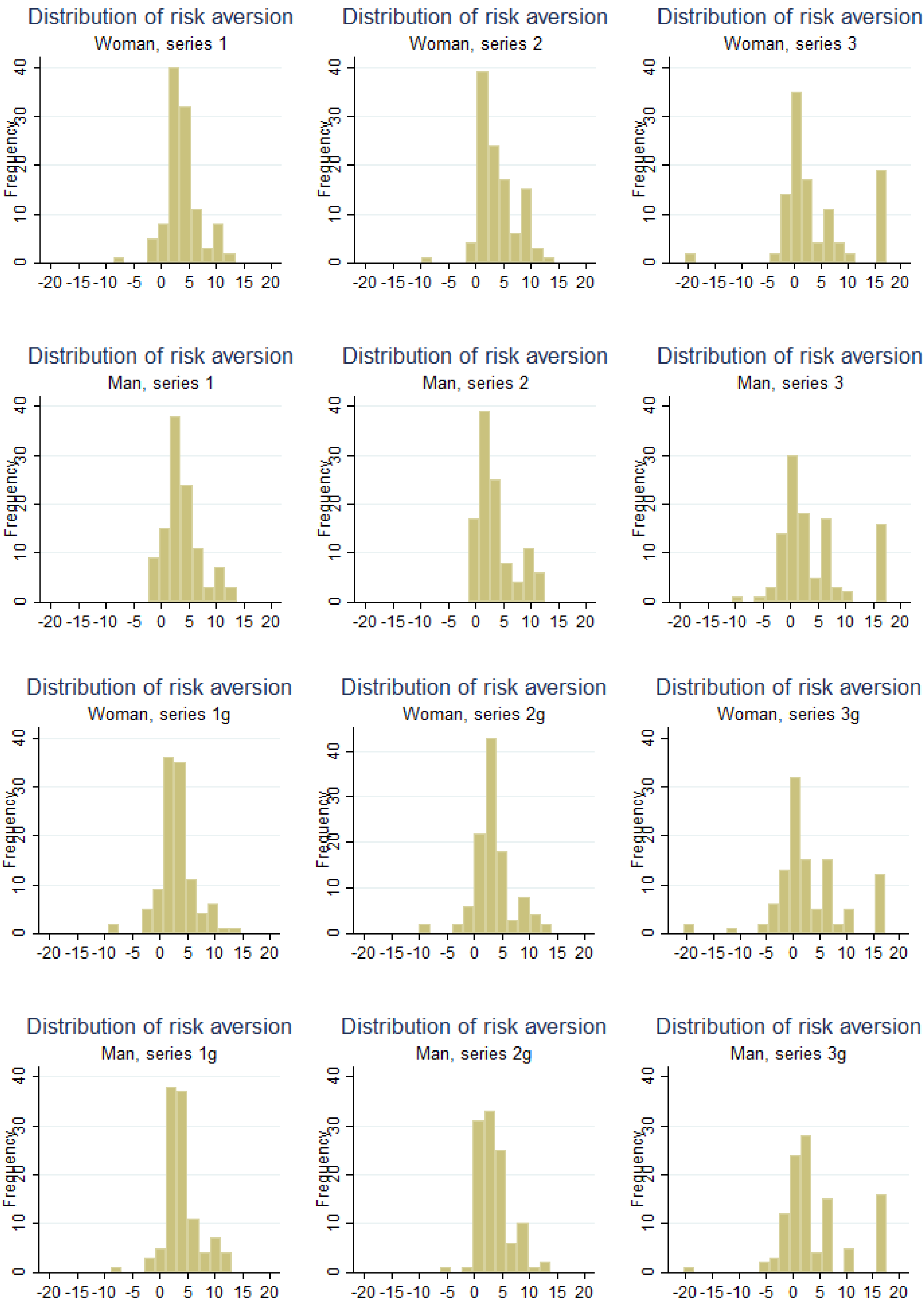

Figure 2: Empirical distributions of computed CRRA risk aversions, individual money

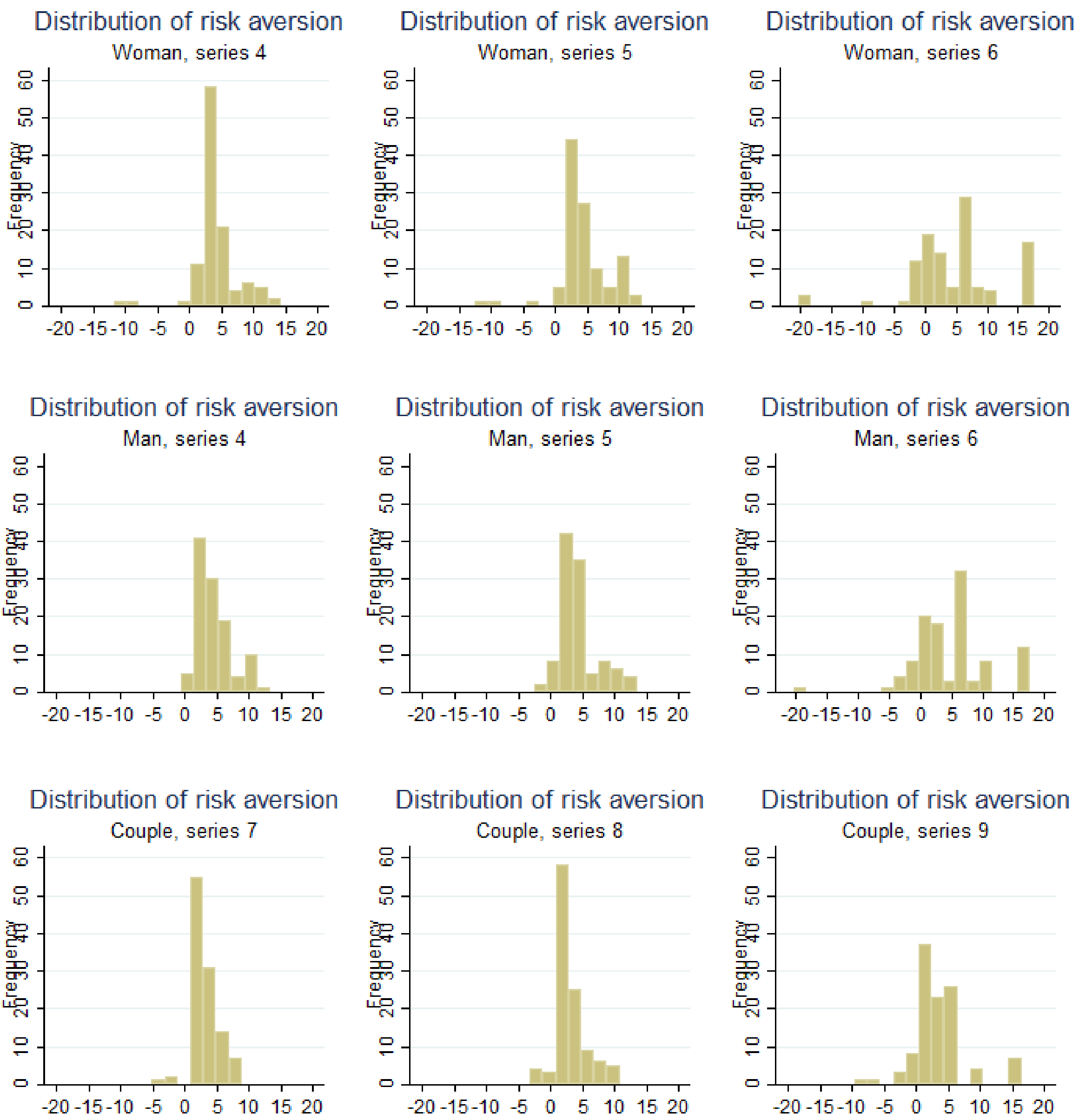

Figure 3: Empirical distributions of computed CRRA risk aversions, couple money

Population-Level Analysis[17] Tables 3 and 4 show correlations between woman guess, woman actual answer, man actual answer and man guess of CRRA levels risk aversions for series involving individual money and correlations between man, woman, and couple CRRA risk aversions for series involving couple money, respectively.

We find no significant assortative mating in terms of (actual) individual risk aversions as well as in terms of guessed risk aversions, meaning that there is no matching on individuals' attitude towards risk.[18] However, individual risk aversions when couple money is involved are correlated, which may be explained by the altruism within the couple.

In addition, when stating the level of risk aversion of their spouse, women appear to be influenced both by their own level of risk aversion than by the level of risk aversion of their spouse, but they appear to be more influenced by their own level of risk aversion.[19] Conversely, men appear to be influenced only by their own preferences.[20] This suggests that women are empathic, while men are not, and, also, given that we provided individuals with financial incentives for stating a good guess, that spouses do not perfectly know each other and use as reference point their own level of risk aversion when guessing.

Lastly, both men and women appear to have bargaining power, but women seem to have more bargaining power relative to men.[21]

	θ_m^F	θ_f^F	θ_m^M	θ_f^M
θ_m^F		0.0000	0.0009	0.1133
θ_f^F	0.3946		0.1279	0.0049
θ_m^M	0.3109	0.1460		0.0000
θ_f^M	0.1518	0.2666	0.4601	

Notes: Figures above the diagonal indicate p-values of the test that the correlation is equal to 0 against it is not.

Table 3: Correlations between Woman guess, Woman actual answer, Man actual answer and Man guess of CRRA risk aversion (series 1-3 and series 1g-3g).

Individual/Couple-Level Analysis The decisions made jointly by spouses are not always a convex combination of decisions of spouses investing their own money: this is the case of the 57 couples for which couple risk aversion is not between individual risk aversions (when individual money is involved). This result already exists in the literature on intra-household experiments (Munro, 2018). When spouses are nonaltruistic and perfectly know each other, nonconvex decisions imply that one spouse in the couple has a negative bargaining power. By contrast, when spouses

[17] For a series- and population-level analysis, see Appendix G.1.
[18] θ_m^M and θ_f^F, θ_c^F and θ_c^M as well as θ_f^M and θ_m^F are not correlated, respectively.
[19] θ_m^F and θ_m^M are more correlated than θ_m^F and θ_f^F are.
[20] θ_f^M and θ_f^F are not correlated but not θ_f^M and θ_m^M.
[21] θ_c^F and θ_c^C are more correlated than θ_c^M and θ_c^C are.

	(θ_c^F, θ_c^M)	(θ_c^F, θ_c^C)	(θ_c^M, θ_c^C)
4/7	0.2232 (0.0191)	0.7125 (0.0000)	0.4236 (0.0000)

Notes: Figures in parenthesis indicate p-values of the test that the correlation is equal to 0 against it is not.

Table 4: Correlations between Man, Woman and couple risk aversion of CRRA risk aversion (series 4-9)

are altruistic and do not perfectly know each other, the nonconvex combination of decisions of spouses can instead also be explained by the altruism and the empathy within the couple.

Consider first the empathy within the couple. Only 43 women and 48 men state a guess about their spouse's preferences between their own preferences and the actual spouse's preferences. 38 women and 35 men state a guess that diverges towards their own preferences, while 29 women and 27 men state a guess that diverges towards their spouse's preferences. These figures suggest women and men are equally empathic.

Turn now to the altruism within the couple. For 77 women and 67 men, the level of risk aversion when investing for the couple is not a convex combination of their own level of risk aversion and their spouse's guessed level of risk aversion.[22] Among them, 33 women and 28 men take a decision that diverges towards their spouse. These two facts together suggest that women are more altruistic than men.

Lastly, we find that for 70 couples, the decisions made jointly by spouses are not a convex combination of decisions of spouses investing for the couple (i.e., couple risk aversion is between individual risk aversions when investing couple money), meaning that, within these couples, one spouse has a negative bargaining power. For 34 couples (resp., 36 couples), this is the woman (resp., the man) who has a negative bargaining power.

5.3.2 Models

Table 5 shows OLS and SUR estimates of the models describing the process starting from individual preferences and leading to couple decisions when spouses do (perfect knowledge) and do not (imperfect knowledge) perfectly know each other.[23] Table 6 shows estimates of the degrees of empathy, altruism and bargaining power defined above.[24] Due to the small number of observations,

[22] For these women, θ_c^F (resp., for these men, θ_c^M) does not belong between θ_f^F and θ_m^F (resp., θ_f^M and θ_f^M).

[23] The OLS estimator assumes that all regressors are exogenous and errors are uncorrelated and the SUR estimator assumes that all regressors are exogenous and errors are correlated. Due to the small number of observations, we ignore endogeneity issues. For dealing with endogeneity, we can implement the 2SLS and the 3SLS estimators.

[24] Consistency of the models requires that for each equation the sum of parameters be equal to one. For instance, in the first equation of both models, we should have $a_{MF} + a_{MM} = 1$. As a consequence, the degree of altruism in Table 6 is computed by $a_{MF}/(a_{MF} + a_{MM})$. Deviation from this situation could reflect both measurement errors in the explanatory variables and/or heterogeneity within the population. Therefore, the constraints that the parameters sum to one should not be imposed when running the regression.

		(1)		(2)		(3)		(4)	
		Imperfect knowledge				Perfect knowledge			
		SUR		OLS		SUR		OLS	
Empathy F	e_{FM}	0.384	(0.000)	0.357	(0.001)	-	-	-	-
	e_{FF}	0.424	(0.000)	0.444	(0.000)	-	-	-	-
Empathy M	e_{MF}	0.346	(0.000)	0.313	(0.000)	-	-	-	-
	e_{MM}	0.496	(0.000)	0.543	(0.000)	-	-	-	-
Altruism F	a_{FM}	0.629	(0.000)	0.518	(0.000)	0.457	(0.000)	0.453	(0.000)
	a_{FF}	0.475	(0.000)	0.551	(0.000)	0.598	(0.000)	0.601	(0.000)
Altruism M	a_{MF}	0.449	(0.000)	0.415	(0.000)	0.195	(0.001)	0.198	(0.004)
	a_{MM}	0.640	(0.000)	0.666	(0.000)	0.844	(0.000)	0.840	(0.000)
Bargaining F	w_F	0.415	(0.000)	0.430	(0.000)	0.432	(0.000)	0.430	(0.000)
Bargaining M	w_M	0.312	(0.000)	0.270	(0.000)	0.289	(0.000)	0.270	(0.000)
Observations		110		110		110		110	

p-values in parentheses

Table 5: Estimates

		Imperfect knowledge		Perfect knowledge	
		(1)	(2)	(3)	(4)
		SUR	OLS	SUR	OLS
Empathy F	$\frac{e_{FM}}{e_{FM}+e_{FF}}$	0.475	0.446	–	–
		[0.305; 0.645]	[0.201; 0.691]	–	–
Empathy M	$\frac{e_{MF}}{e_{MF}+e_{MM}}$	0.411	0.365	–	–
		[0.275; 0.547]	[0.169; 0.562]	–	–
Altruism F	$\frac{a_{FM}}{a_{FM}+a_{FF}}$	0.570	0.485	0.433	0.430
		[0.439; 0.700]	[0.305; 0.664]	[0.299; 0.567]	[0.303; 0.557]
Altruism M	$\frac{a_{MF}}{a_{MF}+a_{MM}}$	0.412	0.384	0.188	0.191
		[0.288; 0.537]	[0.181; 0.588]	[0.081; 0.294]	[0.067; 0.315]
Bargaining F	$\frac{w_F}{w_F+w_M}$	0.571	0.614	0.600	0.614
		[0.485; 0.657]	[0.491; 0.738]	[0.509; 0.691]	[0.491; 0.738]

Table 6: Estimates of degrees

both OLS and SUR estimator lead to poorly estimated parameters. Future research thus involves using larger scale experimental data.

Consider first the results when spouses do not perfectly know each other (columns (1) and (2)). We find that both spouses are empathic and altruistic but that women are slightly more empathic and slightly more altruistic than men. Women have also more bargaining power than men.

Turn now to the results when spouses perfectly know each other (columns (3) and (4)). We find that both spouses are altruistic but that women are far more altruistic than men. Women have also more bargaining power than men.

Lastly, incorrectly assuming that spouses perfectly know each other leads to significantly bias the degree of altruism of men towards women and in a less extent to the degree of altruism of women towards men as well as the degrees of bargaining power of both spouses.

6 Concluding Comments

We study couple decisions under risk: we design an experimental procedure and propose an empirical setting to decompose the process starting from individual preferences and leading to couple decisions. Specifically, we take into account that both individuals may be altruistic towards their spouse and may not perfectly know the preference of their spouse, and that couple decisions may be affected by the relative bargaining power of each spouse.

The protocol allows us to elicit separately the risk aversions of the woman (and of the man) when she (and he) decides for the couple, of the woman when she decides for the couple, and then the risk aversion of the couple when both spouses decide together. This allows us to determine the relative bargaining power of each spouse.

One key element of this protocol is to ask each individual to guess the answers of his/her spouse, so as to elicit the level of risk aversion of the each individual as guessed by his/her spouse. We then define the degree of empathy of the individual as the ability of an individual to state accurate guess of his/her spouse's level of risk aversion.

This guess allows us to examine the knowledge that an individual has about his/her spouse preferences but also the degree of altruism of each individual towards his/her spouse, which measures the extent to which the individual takes into account the consequences of his/her choice on his/her spouse. It appears that incorrectly thinking of the individuals as perfectly knowing the preferences of their spouse leads to misestimate their degree of altruism.

Several results are worth discussing. First, on average, women are slightly more risk averse than men and couples are slightly less risk averse than both men and women.

Second, both men and women are influenced by their preferences when guessing his/her spouse's preferences, thereby suggesting that each individual does not perfectly know the preferences of his/her spouse and uses as reference point his/her own preferences to state the guesses.

Third, we find that, incorrectly assuming that individuals perfectly know the preferences of their spouse, leads to underestimate the degree of altruism of the individuals and to misleadingly conclude that women and men have balanced bargaining power while women are actually slightly less powerful. In addition, women are found to be more empathic and more altruistic than men.

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Appendices

A Details on the Experimental Design

Section 1 of the experiment: Spouses are separated. In step 1, each spouse is asked to answer questions concerning his/her personal characteristics as well as concerning the couple characteristics. In the last three steps, each spouse goes through several investment series. In each series, the spouse has to invest a certain amount of money either in a lottery, modeling the toss of a fair coin, or in a sure payoff. Sure payoffs range from the low outcome of the lottery to the high outcome of the lottery.

- **Step 1. Characteristics of the individual/couple**: First, each spouse is asked to answer questions concerning his/her personal characteristics (age, job status, etc.). Second, each spouse is asked to answer questions concerning his/her financial status (income, real estate, etc.). Finally, the decision weight of each spouse in some of the couple decisions is elicited.

After answering all the questions, each spouse collects 40 € as a reward.

- **Step 2. Training investment series**: Each spouse goes through an investment series which is not payoff-relevant. Each investment decision consists in investing 50 €.
- **Step 3. Investment series 1, 2, and 3**: Each spouse goes through three payoff-relevant investment series. In the first series, each spouse invests 20 out of the 40 € he/she collected. In the second and third series, each spouse invests the entire 40 €.
- **Step 4. Guess Investment series 1, 2, and 3**: Each spouse is asked to guess the replies of his/her spouse to questions of Step 3.
- **Step 5. Investment series 4, 5, and 6**: Each spouse goes through three payoff-relevant investment series. In the first series, each spouse invests 40 out of the 80 € the couple collected. In the second and third series, each spouse invests the entire 80 €.

Section 2 of the experiment: Spouses are together. In step 6, the couple goes through three investment series. In each series, the couple has to invest a certain amount of money either in a lottery, modeling the toss of a fair coin, or in a sure payoff. Sure payoffs range from the low outcome of the lottery to the high outcome of the lottery. In steps 7 to 9, the couple goes through three investment series, including 3 questions each. In each series, the couple has to invest a certain amount of money either in a lottery (specific to each question), modeling the toss of a fair coin, or in a sure payoff (which does not vary within a series). In each series, the lottery proposed in the second question depends on the answer to the first question, and the lottery proposed in the third question depends on the answer to the first and second questions.

- **Step 6. Investment series 7, 8, and 9**: The couple goes through three payoff-relevant investment series. In the first series, the couple invests 40 out of the 80 € the couple collected. In the second and third series, the couple invests the entire 80 €.
- **Step 7. Investment series 10**: Both the amount invested and the sure payoff are 80 €. The couple may loose half of the 80 € in the worst case and increase their payoff up to 140 € in the best case. The expected payoff of all lotteries is 90 €, and the variability of the payoff is increased if the couple previously selected the lottery, decreased if they previously selected the sure payoff.
- **Step 8. Investment series 11**: Similar to Series 10, except that the safe payoff is now 90 € (all amounts in the first question are increased by 10 €).
- **Step 9. Investment series 12**: Similar to Series 11, except that there is no risk of any loss (the payoff in the worst case is 80 €), and instead of increasing/decreasing the variance, only one outcome is increased/decreased depending on the answer to the previous question.

B Efficient Couple Decisions under Risk

In Equations (1) and (2), we state that couple C chooses consumption $\mathbf{x}$ so as to maximise an expected utility, W_C^C, defined as the weighted sum of woman F expected utility, W_F^F (or W_C^F), and man M expected utility, W_M^M (or W_C^M), where the weights are the respective bargaining powers. In this appendix, we show where this result comes from.

The vector of consumptions $c = \left(c^F, c^M\right)$ is *ex ante* efficient if it solves (Browning et al., 2014, see e.g.,)

$$\begin{array}{c} \max \sum_{s=1}^{S} \pi_s u_F^F\left(c_s^F\right) \\ \text{s.t.} \quad \sum_{s=1}^{S} \pi_s u_M^M\left(c_s^M\right) \geq \bar{u}_M^M \\ \sum_{i=1}^{N} p_{i,s}\left(c_{i,s}^F + c_{i,s}^M\right) = y_s^F + y_s^M = y_s, \quad s = 1, \ldots, S, \end{array} \tag{34}$$

where u_F^F and u_M^M are the VNM direct utility functions of woman F and man M, respectively.

If λ denotes the Lagrange multiplier of the first constraint, then program (34) becomes

$$\begin{array}{c} \max \sum_{s=1}^{S} \pi_s u_F^F\left(c_s^F\right) + \lambda \sum_{s=1}^{S} \pi_s u_M^M\left(c_s^M\right) = \sum_{s=1}^{S} \pi_s \left[u_F^F\left(c_s^F\right) + \lambda u_M^M\left(c_s^M\right)\right] \\ \sum_{i=1}^{N} p_{i,s}\left(c_{i,s}^F + c_{i,s}^M\right) = y_s^F + y_s^M = y_s, \quad s = 1, \ldots, S. \end{array} \tag{35}$$

Further assuming that prices do not vary across states ($p_{i,s} = p_i$) and setting $x_s = \sum_{i=1}^{N} p_i c_{i,s}^F$, program (35) amounts to maximise

$$\sum_{s=1}^{S} \pi_s \left[V_F^F (x_s) + \lambda V_M^M (y_s - x_s) \right], \tag{36}$$

that is, to maximise

$$\begin{aligned} W_C^C (\mathbf{y}, \boldsymbol{\pi}) &= \sum_{s=1}^{S} \pi_s \left[\mu V_F^F (x_s) + (1-\mu) V_M^M (y_s - x_s) \right], &(37)\\ &= \mu W_F^F (\mathbf{x}, \boldsymbol{\pi}) + (1-\mu) W_M^M (\mathbf{y} - \mathbf{x}, \boldsymbol{\pi}), &(38) \end{aligned}$$

We obtain (7) and (8) in the same way by replacing V_F^F and V_M^M with V_C^F and V_C^M, respectively.

C Extension to Risk-loving

Consider that woman F and man F are of the CARA type with coefficient of risk aversion θ_f^F and θ_m^M. Then, couple C solves

$$W_C^C (\mathbf{y}, \boldsymbol{\pi}) = \max_{x_1,\dots,x_S} \sum_{s=1}^{S} \pi_s \left[\mu V_F^F (x_s) + (1-\mu) V_M^M (y_s - x_s) \right],$$

where

$$V_A^A (x) = \frac{1 - \exp\left(-\theta_a^A x\right)}{\theta_a^A}, \quad A \in \{F, M\}.$$

When individuals are egoistic and risk averse, as in Mazzocco (2007), then, under *ex ante* efficiency, the couple is also of the CARA type with a coefficient of absolute risk aversion θ_c^C satisfying (see also Wilson, 1968; Hara et al., 2007):

$$\frac{1}{\theta_c^C} = \frac{1}{\theta_f^F} + \frac{1}{\theta_m^M}, \tag{39}$$

meaning that couple C's preferences does not depend on spouses' bargaining powers.

This result holds only when either both spouses are risk-averse ($\theta_f^F > 0$ and $\theta_m^M > 0$), or when only one spouse is risk-lover but not too much compared to the other spouse (i.e., the sum of risk aversions is positive: $\theta_a^A > 0$ and $\theta_b^B < 0$ with $\theta_a^A + \theta_b^B > 0$).[25] The result does not hold when both

[25] In the latter case, the couple is risk-lover since

$$\theta_c^C = \frac{\theta_m^M \theta_f^F}{\theta_m^M + \theta_f^F} < 0.$$

spouses are risk-lover ($\theta_f^F < 0$ and $\theta_m^M < 0$). This is because the *ex post* sharing rule given by

$$x_s = \frac{\theta_m^M}{\theta_m^M + \theta_f^F} y_s + \frac{\ln\left(\dfrac{\mu}{1-\mu}\right)}{\theta_m^M + \theta_f^F},$$

maximises

$$W_C^C\left(y_1, ..., y_S; \mu\right) = -\sum_{s=1}^{S} \pi_s \exp\left(-\frac{\theta_f^F \theta_m^M}{\theta_f^F + \theta_m^M} y_s\right),$$

provided that the second-order condition of the couple's program is satisfied, that is,

$$-\left(\theta_f^F + \theta_m^M\right)\exp\left(-\theta_f^F x_s\right) = -\mu\left(\theta_f^F + \theta_m^M\right)\exp\left(-\theta_m^M\left(y_s - x_s\right)\right) < 0,$$

which is equivalent to $\theta_f^F + \theta_m^M > 0$.

Note that x_s is a linear function of y_s: the slope depends only on preferences and the intercept depends only on the relative bargaining powers.

Assume that man M is risk lover and that woman F is risk averse with $\theta_f^F + \theta_m^M > 0$. When the good states realise, the risk lover spouse looses while the risk averse spouse wins; and vice-versa when the bad states realise. In addition $\sigma\left(x_s\right) < \sigma\left(y_s - x_s\right)$. Because of the risk lover spouse, the couple takes more risk and the risk lover spouse, and the risk lover spouse bears a majority of the risk and at the same time his/her expected gain decreases with the couple's expected gain.

Proposition 5 *Proposition 1 does not hold if at least one spouse is risk-lover and the risk aversion of the risk-averse individual is larger than the risk loving of his/her spouse.*

D Aggregation: Computation of Individual-Specific Levels of Risk Aversion

We compute individual-specific levels of risk aversions, θ_n by computing step by step the weighted average of the individual- and series-specific levels of risk aversions, $\theta_n\left(j\right) - \delta_j$, where the weights are chosen so as to minimise the variance of the weighted average in the sample.

For each individual, each step is composed of three investment series and results in three measures of level of risk aversions $\theta_n\left(1\right) - \delta_1$, $\theta_n\left(2\right) - \delta_2$, and $\theta_n\left(3\right) - \delta_3$. These measures are stacked into vectors $\theta\left(1\right) - \delta_1$, $\theta\left(2\right) - \delta_2$, and $\theta\left(3\right) - \delta_3$ for the entire sample, respectively. Let $\operatorname{cov}\left(\theta\left(i\right) - \delta_i, \theta\left(j\right) - \delta_j\right) = \sigma_{ij}^2$, $i, j \in \{1, 2, 3\}$. Then the variance of the weighted average in the

Note that the sum of risk aversions is positive ($\theta_f^F + \theta_m^M > 0$), while the sum of risk tolerances is negative ($1/\theta_f^F + 1/\theta_m^M < 0$).

sample is given by

$$V\left(\sum_{j=1}^{3} w_j \theta(j) - \delta_j\right) = w_1^2\sigma_{11}^2 + w_2^2\sigma_{22}^2 + w_3^2\sigma_{33}^2 + 2w_1w_2\sigma_{12}^2 + 2w_1w_3\sigma_{13}^2 + 2w_2w_3\sigma_{23}^2. \tag{40}$$

We choose (w_1^*, w_2^*, w_3^*) so as to minimise $V\left(\sum_{i=1}^{3} w_i\theta_i\right)$ subject to $w_1 + w_2 + w_3 = 1$.

The first-order conditions are given by

$$\begin{bmatrix} \sigma_{11}^2 & \sigma_{12}^2 & \sigma_{13}^2 \\ \sigma_{12}^2 & \sigma_{22}^2 & \sigma_{23}^2 \\ \sigma_{13}^2 & \sigma_{23}^2 & \sigma_{33}^2 \end{bmatrix} \begin{bmatrix} w_1 \\ w_2 \\ w_3 \end{bmatrix} = \frac{1}{2} \begin{bmatrix} \lambda \\ \lambda \\ \lambda \end{bmatrix}, \tag{41}$$

and

$$w_1 + w_2 + w_3 = 1.$$

The optimal (w_1^*, w_2^*, w_3^*) solves these first-order conditions.

E Consistency of Answers

Within-series consistency Table 7 shows, for each investment series, the relative frequency of inconsistent sets of choices for women, men, and couples. Altogether, there were 20.5% (respectively 18.5% and 5.2%) of inconsistent sets of choices for women (respectively for men and for couples). The fraction of inconsistent series is roughly constant within each group of questions, and significantly differs between the 3 groups of investment series. When individuals decide alone for their own money, the inconsistency rate is about 25.6%, ranging between 20.9% and 30.9% for the different series and genders. Globally, the inconsistency rate is the same for men and women, and we observe that it is lower in investment series 2 both for men and women, compared to investment series 1 and 3. When individuals decide alone for couple money, the global inconsistency rate goes down to 15.8% for women and 10.9% for men, and men are significantly less inconsistent than women. Note that this global decrease in inconsistency rate when going from individual money to couple money cannot result only from a learning process. Indeed, the inconsistency rate increases across these 3 series for women (maybe become they become less and less concentrated), but not for men. It might be that individuals are more concentrated when they have to invest couple money because they understand that their choices have consequences on their spouse. A more obvious result is that couples are by far more consistent than individuals, since the inconsistency rate is only 5.2% for couples.

Out of the 2^{11} potential sets of choices in a given investment series, only 12 are consistent, which define 12 ordered classes of risk aversion. They are represented in Table 8, together with the frequencies of observed answers in each series, for women, men, and couples. We observe that a significant proportion of individuals (especially women) are willing to receive always less money just for the benefit of avoiding any risk (44 out of 110×6 women-series and 23 out of 110×6 men-series). We denote by Locally Opposed to Risk for lottery $L_j\{L_j - \text{OR}\}$, those decision-makers who consistently prefer any sure payoff $S_j(i)$, $i = 1...11$, to lottery L_j in investment series j. $L_j - \text{OR}$ preferences are never shared by both spouses in a couple nor by the two spouses together, i.e., no $L_j - \text{OR}$ individual was able to convince his/her spouse.

Investment series	Woman	Man	Couple
1 (Woman & Man)	32/110	28/110	
2 (Woman & Man)	23/110	24/110	
3 (Woman & Man)	28/110	34/110	
4 (Woman & Man)/7 (Couple)	6/110	13/110	7/110
5 (Woman & Man)/8 (Couple)	16/110	6/110	4/110
6 (Woman & Man)/9 (Couple)	30/110	17/110	6/110
Total individual series (1 - 6)	83/330	86/330	
Total couple series (7 - 9)	52/330	36/330	17/330

Table 7: Relative frequencies of inconsistent series of choice

Switching point	Set of consistent choices	Investment series: Woman, Man; Couple					
		1	2	3	4;7	5;8	6;9
0	$\mathcal{L}_j \succ_k C_j(1)$	4,0	3,0	2,2	0,0;0	1,0;0	0,0;0
1	$C_j(1) \succ_k \mathcal{L}_j \succ_k C_j(2)$	1,0	1,0	2,0	2,0;0	2,0;0	3,1;0
2	$C_j(2) \succ_k \mathcal{L}_j \succ_k C_j(3)$	0,0	0,0	0,1	0,0;1	0,0;0	0,0;1
3	$C_j(3) \succ_k \mathcal{L}_j \succ_k C_j(4)$	3,2	0,0	0,1	0,1;2	0,1;2	0,1;1
4	$C_j(4) \succ_k \mathcal{L}_j \succ_k C_j(5)$	2,2	2,4	0,2	0,3;0	0,3;1	1,4;3
5	$C_j(5) \succ_k \mathcal{L}_j \succ_k C_j(6)$	9,10	4,8	6,7	10,7;7	5,6;3	4,8;6
6	$C_j(6) \succ_k \mathcal{L}_j \succ_k C_j(7)$	13,18	13,19	33,29	16,19;26	12,17;13	16,19;37
7	$C_j(7) \succ_k \mathcal{L}_j \succ_k C_j(8)$	12,18	19,14	14,12	20,19;22	17,24;25	10,17;21
8	$C_j(8) \succ_k \mathcal{L}_j \succ_k C_j(9)$	19,14	16,13	4,5	27,23;26	19,12;22	25,24;24
9	$C_j(9) \succ_k \mathcal{L}_j \succ_k C_j(10)$	5,8	11,11	2,1	16,15;13	18,28;30	4,7;4
10	$C_j(10) \succ_k \mathcal{L}_j \succ_k C_j(11)$	3,8	13,12	10,10	7,6;6	13,8;10	7,8;7
11	$C_j(11) \succ_k \mathcal{L}_j\{\mathcal{L}_j - \text{OR}\}$	7,2	5,2	9,6	6,4;0	7,5;0	10,4;0

Table 8: The 12 sets of consistent replies

Between-series consistency Consistency between series requires that the choices in the same context (i.e., when investing alone his/her own money, when investing alone couple's money, when deciding together couple's money) lead to a unique coefficient of risk aversion (i.e., that the correlation of risk aversions between series is equal to 1).

When investing their own money, men's answers are slightly more consistent across series than women's answers. In contrast, when investing couple's money, women's answers become more consistent across series than men's, although they are less consistent within series. Lastly, while couples' answers are far more consistent within series than their members, they are not significantly more consistent between series.

Series	1	2	3	Average
1		0.5196	0.3594	0.8872
2	0.5124		0.5895	0.8345
3	0.4989	0.6795		0.4061
Average	0.8901	0.7784	0.4452	

Notes: All correlations are significant at 0.1% level.

Table 9: Correlations between risk aversion levels (CRRA utility) across series Individual money, for Men (below diagonal) and Women (above diagonal)

Series	4	5	6	Average
4		0.7360	0.6619	0.9322
5	0.7769		0.6203	0.8146
6	0.5426	0.5063		0.4315
Average	0.9848	0.8252	0.4267	

Notes: All correlations are significant at 0.1% level.

Table 10: Correlations between risk aversion levels (CRRA utility) across series Couple money, for Man (below diagonal) and Women (above diagonal).

Series	7	8	9
8	0.6923		
9	0.6192	0.6373	
Average	0.9535	0.7584	0.4336

Notes: All correlations are significant at 0.1% level.

Table 11: Correlations between risk aversion levels (CRRA utility) across series, Couple money.

F Tests of Specifications

	(1) Series $1-3$	(2) Series $1-3$	(3) Series $4-6$	(4) Series $4-6$	(5) Series $7-9$	(6) Series $7-9$	(7) Series $1g-3g$	(8) Series $1g-3g$
Woman	1.765	1.783	0.996	1.068			-1.189	-1.142
	(0.188)	(0.192)	(0.423)	(0.393)			(0.376)	(0.398)
Age F	0.947	0.927	1.247	1.340	0.830	0.892	1.357	1.378
	(0.144)	(0.163)	(0.036)	(0.026)	(0.436)	(0.406)	(0.039)	(0.038)
Age M	-0.675	-0.716	0.140	0.183	0.292	0.285	0.0120	0.00640
	(0.231)	(0.215)	(0.794)	(0.736)	(0.703)	(0.712)	(0.984)	(0.991)
Partnership duration × Woman	0.0371	0.0374	0.0242	0.0166			0.0451	0.0421
	(0.542)	(0.549)	(0.665)	(0.769)			(0.466)	(0.498)
Partnership duration × Man	0.171	0.172	0.0969	0.0927			0.0505	0.0504
	(0.002)	(0.003)	(0.066)	(0.081)			(0.385)	(0.388)
Partnership duration					0.0173	0.0141		
					(0.616)	(0.684)		
Constant	2.101	2.065	3.642	3.689	2.678	2.696	3.651	3.643
	(0.016)	(0.020)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Series $1/4/7/1g$					-1.655	-1.064		
					(0.000)	(0.053)		
Series $2/5/8/2g$					-0.785	-0.224		
					(0.007)	(0.678)		
Series $1/4/7/1g$ × Age F	-2.512	-2.082	-2.548	-1.637			-1.821	-1.665
	(0.000)	(0.001)	(0.000)	(0.018)			(0.000)	(0.002)
Series $1/4/7/1g$ × Age M	-2.397	-1.564	-2.485	-1.612			-1.947	-1.618
	(0.000)	(0.021)	(0.000)	(0.018)			(0.000)	(0.004)
Series $2/5/8/2g$ × Age F	-1.232	-0.608	-1.652	-0.786			-0.663	-0.442
	(0.015)	(0.349)	(0.001)	(0.248)			(0.110)	(0.411)
Series $2/5/8/2g$ × Age M	-1.477	-0.800	-2.038	-1.152			-1.673	-1.421
	(0.003)	(0.226)	(0.000)	(0.087)			(0.000)	(0.008)
Lottery 1		-2.617		-2.341		-1.011		-0.931
		(0.000)		(0.000)		(0.094)		(0.122)
LotVal2		-0.787		-0.918		-0.719		-0.177
		(0.233)		(0.187)		(0.254)		(0.750)
LotVal3		-0.0924		-0.481		-0.511		0.123
		(0.892)		(0.466)		(0.392)		(0.828)
LotVal4		0.191		-0.646		-0.275		-0.0233
		(0.786)		(0.400)		(0.696)		(0.969)
LotVal5		-0.498		-0.371		-0.561		-0.541
		(0.466)		(0.593)		(0.378)		(0.350)
σ_u	3.845	4.007	3.585	3.645	2.540	2.554	4.146	4.181
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
σ_e	3.211	3.074	3.131	3.046	1.999	1.982	2.676	2.652
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Log likelihood	-1204.384	-1194.592	-1308.042	-1299.076	-620.537	-618.835	-1253.409	-1251.249
p-value LR Test	0.0015		0.0030		0.6378		0.5043	
Observations	630		650		330		638	

p-values in parentheses

Table 12: Specifications for Test $H_0 : \forall l = 1, \ldots, 5,\ \delta_l = 0$ against $H_1 : \exists l = 1, \ldots, 5,\ \delta_l \neq 0$

	(1) Series $1-3$	(2) Series $1-3$	(3) Series $4-6$	(4) Series $4-6$	(5) Series $7-9$	(6) Series $1g-3g$	(7) Series $1g-3g$
Woman	1.743	1.654	1.051	1.168	-0.304	-1.182	-0.829
	(0.202)	(0.204)	(0.399)	(0.323)	(0.261)	(0.380)	(0.526)
Age F	0.901	0.897	1.322	1.319	0.844	1.343	1.358
	(0.175)	(0.176)	(0.027)	(0.027)	(0.432)	(0.042)	(0.040)
Age M	-0.696	-0.695	0.183	0.178	0.345	-0.00348	0.00563
	(0.228)	(0.227)	(0.735)	(0.741)	(0.656)	(0.995)	(0.992)
Partnership duration × Woman	0.0390	0.0393	0.0185	0.0185		0.0453	0.0437
	(0.532)	(0.528)	(0.742)	(0.741)		(0.465)	(0.481)
Partnership duration × Man	0.171	0.171	0.0937	0.0941		0.0512	0.0508
	(0.003)	(0.003)	(0.076)	(0.075)		(0.380)	(0.384)
Partnership duration					0.0148		
					(0.671)		
Constant	2.074	2.122	3.676	3.617	2.846	3.638	3.488
	(0.019)	(0.013)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Series $1/4/7/1g$		-2.080		-2.169	-1.557		-1.780
		(0.000)		(0.000)	(0.000)		(0.000)
Series $2/5/8/2g$		-0.974		-1.469	-0.697		-1.071
		(0.007)		(0.000)	(0.022)		(0.000)
Series $1/4/7/1g$ × Age F	-2.280		-2.184			-1.760	
	(0.000)		(0.000)			(0.000)	
Series $1/4/7/1g$ × Age M	-1.865		-2.149			-1.763	
	(0.000)		(0.000)			(0.000)	
Series $2/5/8/2g$ × Age F	-0.877		-1.264			-0.554	
	(0.077)		(0.009)			(0.185)	
Series $2/5/8/2g$ × Age M	-1.042		-1.653			-1.546	
	(0.037)		(0.000)			(0.000)	
Lottery 1	-2.382	-2.334	-1.818	-1.818	-0.540	-0.828	-0.774
	(0.000)	(0.000)	(0.000)	(0.000)	(0.183)	(0.092)	(0.113)
σ_u	4.003	3.996	3.623	3.622	2.564	4.173	4.170
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
σ_e	3.088	3.093	3.060	3.060	1.979	2.660	2.678
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Log likelihood	-1195.853	-1196.239	-1300.013	-1300.280	-619.582	-1251.996	-1254.005
p-value LR Test	0.6797		0.7658		0.6378	0.1342	
Observations	630		650		330	638	

p-values in parentheses

Table 13: Specifications for Test $H_0 : \forall k = 1, 2 \quad \delta_{kM} = \delta_{kF}$ against $H_1 : \exists k = 1, 2, \quad \delta_{kM} \neq \delta_{kF}$.

	(1) Series $1-3$	(2) Series $1-3$	(3) Series $4-6$	(4) Series $4-6$	(5) Series $7-9$	(6) Series $7-9$	(7) Series $1g-3g$	(8) Series $1g-3g$
Woman	1.654	1.728	1.168	1.165	0.902	0.906	-0.829	-0.881
	(0.204)	(0.196)	(0.323)	(0.338)	(0.001)	(0.002)	(0.526)	(0.509)
Age F	0.897	0.888	1.319	1.349	0.808	0.824	1.358	1.354
	(0.176)	(0.192)	(0.027)	(0.028)	(0.448)	(0.447)	(0.040)	(0.045)
Age M	-0.695	-0.733	0.178	0.181	0.394	0.434	0.00563	0.0141
	(0.227)	(0.215)	(0.741)	(0.745)	(0.607)	(0.578)	(0.992)	(0.981)
Partnership duration × Woman	0.0393	0.0412	0.0185	0.0193			0.0437	0.0428
	(0.528)	(0.519)	(0.741)	(0.739)			(0.481)	(0.499)
Partnership duration × Man	0.171	0.178	0.0941	0.0953			0.0508	0.0506
	(0.003)	(0.003)	(0.075)	(0.080)			(0.384)	(0.396)
Partnership duration					0.0136	0.0106		
					(0.694)	(0.762)		
Constant	2.122	1.113	3.617	2.508	2.211	1.556	3.488	2.661
	(0.013)	(0.192)	(0.000)	(0.002)	(0.000)	(0.001)	(0.000)	(0.002)
Series 1/4/7/1g	-2.080		-2.169		-1.534		-1.780	
	(0.000)		(0.000)		(0.000)		(0.000)	
Series 2/5/8/2g	-0.974		-1.469		-0.649		-1.071	
	(0.007)		(0.000)		(0.029)		(0.000)	
Lottery 1	-2.334	-3.096	-1.818	-2.627	-0.711	-1.232	-0.774	-1.505
	(0.000)	(0.000)	(0.000)	(0.000)	(0.076)	(0.002)	(0.113)	(0.002)
sigma_u	3.996	4.082	3.622	3.700	2.549	2.570	4.170	4.237
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
sigma_e	3.093	3.243	3.060	3.222	1.938	2.062	2.678	2.799
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Log-likelihood	-1196.239	-1212.960	-1300.280	-1320.623	-614.284	-627.64437	-1254.005	-1271.250
p-value LR Test	0.0000		0.0000		0.0000		0.0000	
Observations	630		650		330		638	

p-values in parentheses

Table 14: Specifications for Test $H_0 : \delta_1 = \delta_2 = 0$ against $H_1 : \exists k = 1, 2,\ \delta_k \neq 0$

G More Evidence on From Individual Preferences to Couple Decision under Risk

G.1 Population-Level Analysis

Table 15 shows correlations between woman guess, woman actual answer, man actual answer and man guess of CRRA levels risk aversions for each series $1-3$ and $1g-3g$. We find no significant assortative mating in terms of actual risk aversions, which means that there is no matching on individuals' attitude towards risk.[26] Similarly, there is no matching on guessed risk aversions.[27]

Moreover, women seem to be empathic, while men do not.[28] At the same time, both women and men are influenced by their preferences when guessing his/her spouse's preferences.[29] When stating the preferences of his/her spouses, each spouse is more influenced by his/her own preferences than by those of his/her spouse.

Given that we provided individuals with financial incentives for stating a good guess, this argues

[26] $\theta_m^M(j,l)$ and $\theta_f^F(j,l)$ are not correlated, except for series 2.

[27] $\theta_f^M(j,l)$ and $\theta_m^F(j,l)$ are not correlated for each series.

[28] $\theta_m^F(j,l)$ and $\theta_m^M(j,l)$ are correlated for each series, while $\theta_f^M(j,l)$ and $\theta_f^F(j,l)$ are not correlated, except for series 2

[29] $\theta_m^F(j,l)$ and $\theta_f^F(j,l)$, and $\theta_f^M(j,l)$ and $\theta_m^M(j,l)$, respectively, are correlated for each series

in favor of the scenario that spouses do not perfectly know each other and use as reference point their own preferences to state the guesses.

	Series	θ_m^F	θ_f^F	θ_m^M	θ_f^M
θ_m^F	Series 1		0.0002	0.0000	0.4870
	Series 2		0.0000	0.0155	0.1634
	Series 3		0.0000	0.0112	0.3840
θ_f^F	Series 1	0.3454		0.3875	0.0572
	Series 2	0.4376		0.0332	0.0036
	Series 3	0.5734		0.0822	0.3864
θ_m^M	Series 1	0.3993	0.0832		0.0000
	Series 2	0.2303	0.2033		0.0000
	Series 3	0.2409	0.1665		0.0000
θ_f^M	Series 1	0.0670	0.1819	0.3818	
	Series 2	0.1338	0.2755	0.5409	
	Series 3	0.0838	0.0834	0.4711	

Notes: Figures above the diagonal indicate p-values of the test that the correlation is equal to 0 against it is not.

Table 15: Correlations between Woman guess, Woman actual answer, Man actual answer and Man guess of CRRA risk aversion, by series (series 1-3 and series 1g-3g).

Table 16 shows correlations between man, woman, and couple CRRA risk aversions for investment series 4-9. It suggests that there is no assortative mating in terms of risk aversions (since θ_c^F and θ_c^M are not correlated, except for series 5). Moreover, both men and women have bargaining power, but women seem to have more bargaining power.[30]

	(θ_c^F, θ_c^M)	(θ_c^F, θ_c^C)	(θ_c^M, θ_c^C)
4/7	0.1602	0.7000	0.4065
	(0.0946)	(0.0000)	(0.0000)
5/8	0.3965	0.6472	0.5871
	(0.0000)	(0.0000)	(0.0000)
6/9	0.1488	0.5178	0.4618
	(0.1207)	(0.0000)	(0.0000)

Notes: Figures in parenthesis indicate p-values of the test that the correlation is equal to 0 against it is not.

Table 16: Correlations between Man, Woman and couple risk aversion of CRRA risk aversion, by series (series 4-9)

[30] θ_c^F and θ_c^C are more correlated than θ_c^M and θ_c^C are.

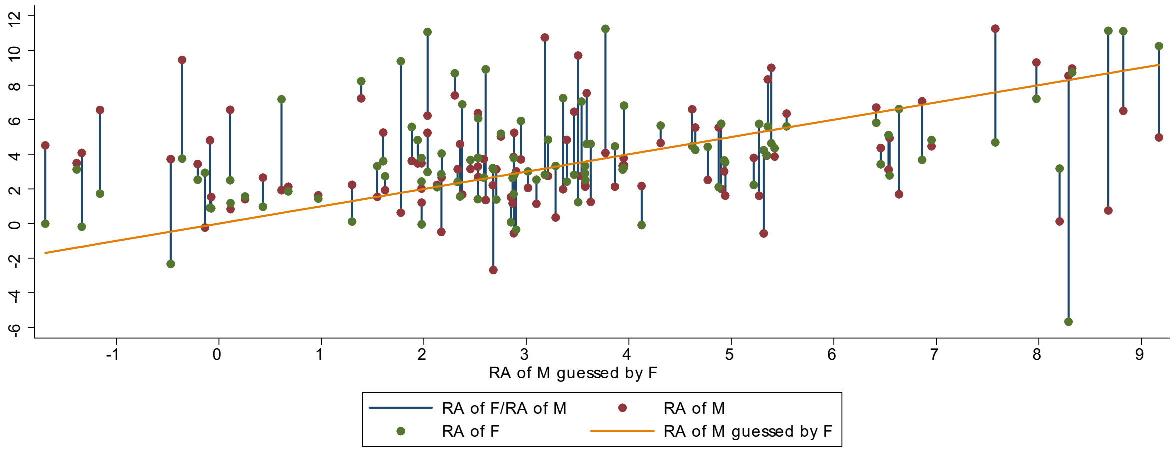

Figure 4: Empathy of woman towards man

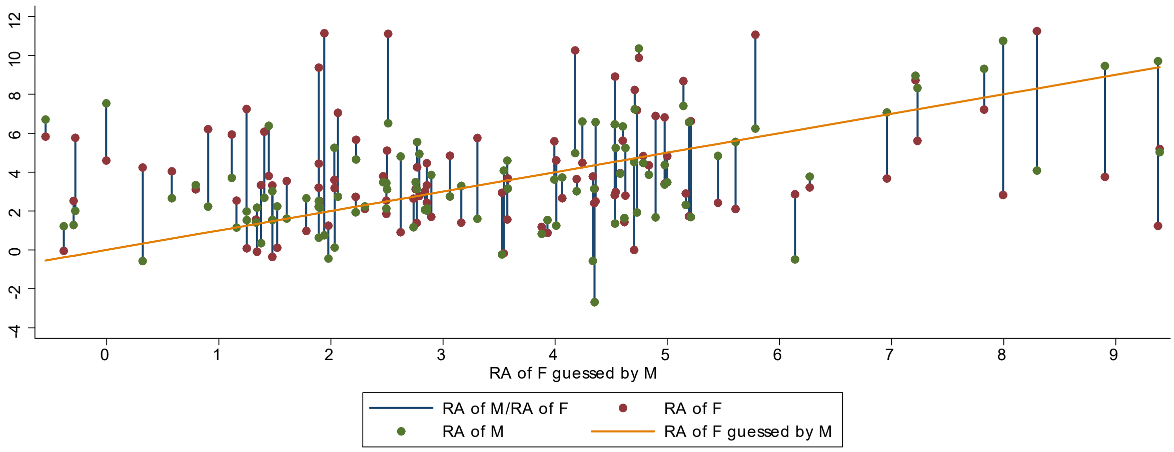

Figure 5: Empathy of man towards woman

G.2 Individual/Couple-Level Analysis

Figure 4 (resp., Figure 5) illustrates the location of the level of risk aversion of woman F as guessed by man M, θ_f^M, (resp., of man M as guessed by woman F, θ_m^F) with respect to the levels of risk aversion of woman F and man M, θ_f^F and θ_m^M. Figure 6 (resp., Figure 7) illustrates the location of the level of risk aversion of woman F investing for couple C (resp., of man M investing for couple C) with respect to the levels of risk aversion of woman F, θ_f^F (resp., of man M, θ_m^M) and of man M as guessed by woman F, θ_m^F (resp., of woman F as guessed by man M, θ_f^M). Figure 8 illustrates the location of the level of risk aversion of couple C with respect to the levels of risk aversion of woman F and man M investing for couple C, θ_c^F and θ_c^M. To ease exposition, we have removed from these figures the outliers. In Table 17, we provide descriptive statistics for these outliers.

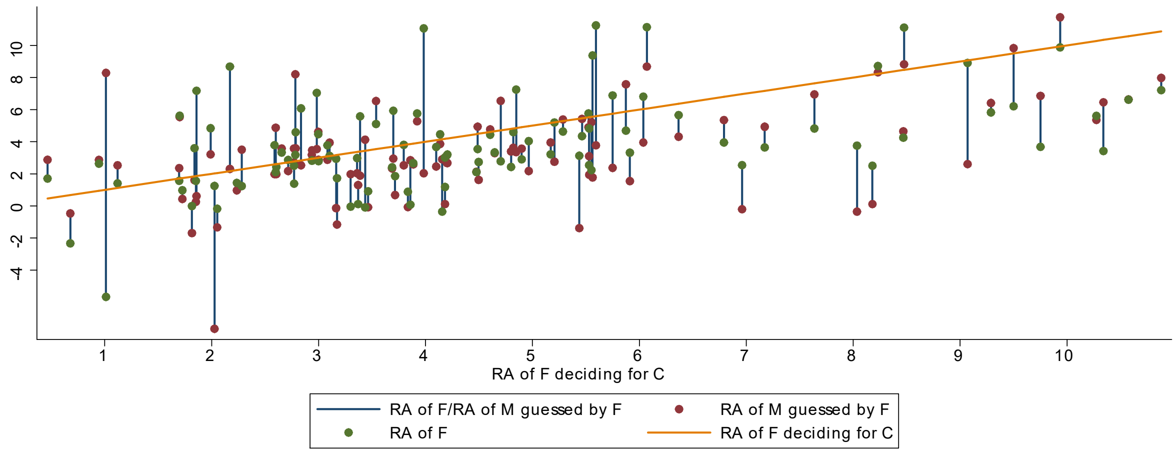

Figure 6: Altruism of woman towards man

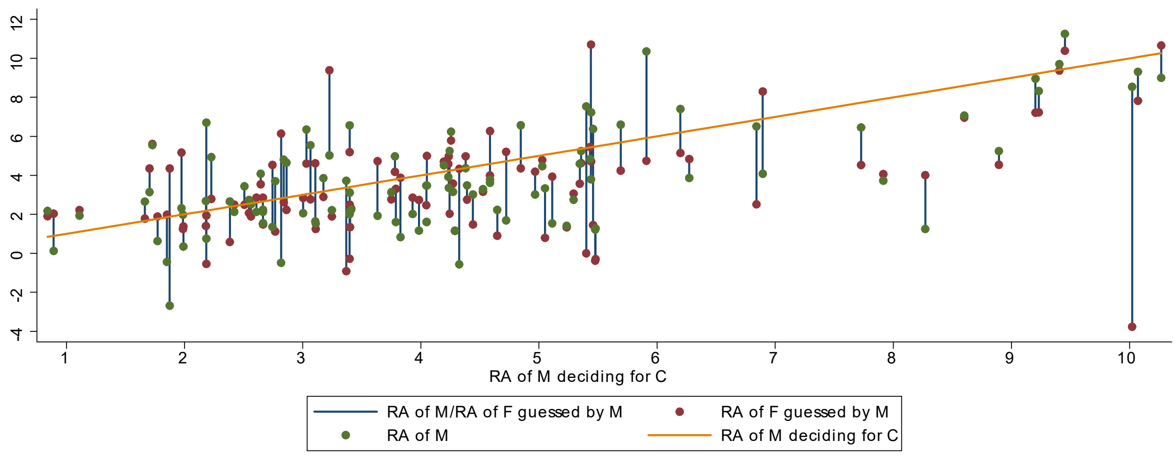

Figure 7: Altruism of man towards woman

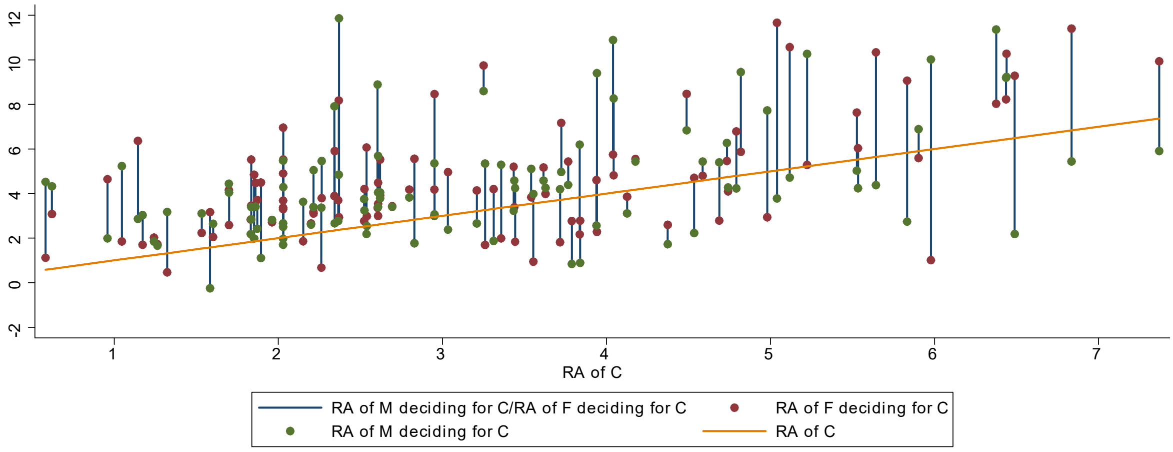

Figure 8: Bargaining power of woman relative to man

Outliers	Inconsistencies								
Empathy F	Series 1g	Series 2g	Series 3g	θ_m^F	θ_m^M	θ_f^F	Age F	Age M	Partnership duration
Couple 93	0	0	0	-11.4959	1.2821	2.5231	29	37	2
Couple 42	0	0	0	-7.6611	-0.4450	1.2485	26	27	5
Couple 94	0	0	0	9.8366	2.2306	6.2077	50	53	21
Couple 68	0	0	0	11.7578	10.3561	9.8769	55	57	32
Empathy M	Series 1g	Series 2g	Series 3g	θ_f^M	θ_f^F	θ_m^M	Age F	Age M	Partnership duration
Couple 53	0	0	0	-3.7652	-5.6715	8.5409	53	54	30
Couple 34	0	0	0	-0.9152	-2.3320	3.7231	39	46	17
Couple 24	0	0	0	10.3915	4.6891	11.258	50	50	30
Couple 19	1	0	1	10.6612	4.6364	9.0008	67	66	38
Couple 78	0	0	0	10.7100	2.2306	3.7966	38	43	19
Altruism F	Series 4	Series 5	Series 6	θ_c^F	θ_m^F	θ_f^F	Age F	Age M	Partnership duration
Couple 93	0	0	0	-9.3330	-11.4959	2.5231	29	37	2
Couple 61	0	0	0	-7.6851	5.3157	4.2368	29	33	2
Couple 2	0	0	0	11.4049	1.3890	8.2243	49	50	30
Couple 23	0	0	0	11.6670	9.1723	10.2560	59	63	40
Altruism M	Series 4	Series 5	Series 6	θ_c^M	θ_f^M	θ_m^M	Age F	Age M	Partnership duration
Couple 3	0	0	0	-0.2478	3.5264	-0.2303	43	45	1
Couple 61	0	0	0	0.5799	0.3207	-0.5705	29	33	2
Couple 72	0	0	1	10.8910	4.8957	1.6738	58	57	32
Couple 7	0	0	0	11.3601	8.9040	9.4569	48	55	35
Couple 37	0	0	0	11.8652	7.9953	10.7480	57	59	39
Bargaining F	Series 7	Series 8	Series 9	θ_c^C	θ_c^F	θ_c^M	Age F	Age M	Partnership duration
Couple 93	0	1	0	-4.4281	-9.3330	5.4799	29	37	2
Couple 61	0	0	0	-1.4178	-7.6851	0.5799	29	33	2
Couple 8	0	0	0	-0.9939	2.6045	3.9307	41	41	15
Couple 94	0	0	0	8.2384	9.4999	4.6474	50	53	21
Couple 66	0	0	0	8.4511	10.8811	10.0706	52	54	32

Table 17: Outliers

H CARA Utilities: Test for Unitary Model

In this subsection, assuming CARA utilities, we show evidence that the relation between couple C's level of risk aversion, θ_c^C, and individuals F and M's levels of risk aversions, θ_m^M and θ_f^F, given by Equation (39), does not hold.

When individuals of the CARA type are egoistic and risk averse, as in Mazzocco (2007), then, under *ex ante* efficiency, the couple is also of the CARA type with a coefficient of absolute risk aversion θ_c^C satisfying (see also Wilson, 1968; Hara et al., 2007):

$$\frac{1}{\theta_c^C} = \frac{1}{\theta_f^F} + \frac{1}{\theta_m^M}, \tag{42}$$

where θ_f^F and θ_m^M are woman F and man M's levels of risk aversion, respectively. This means that, with spouses of the CARA types, couple C's preferences does not depend on spouses' bargaining powers.

We test this relation by running the following OLS regression:

$$\frac{1}{\theta_c^C} = \beta_F \frac{1}{\theta_f^F} + \beta_M \frac{1}{\theta_m^M} + \epsilon, \tag{43}$$

where ϵ is the econometric error term; and then by testing the null hypothesis that both β_F and β_M are equal to one (against the alternative that at least one of them is not).

	(1) $1/\theta_c^C$
$1/\theta_f^F$	1.302
	(0.000)
$1/\theta_m^M$	0.387
	(0.025)
Observations	110

p-values in parentheses

Table 18: Test for CARA Utility

The test leads us to reject the hypothesis that both parameters are equal to 1 (p-value equal to 0.0000).