A Study of Intra-household and Gender Differences in Risk Preferences and Their Effect on Household Investment Decisions in Rural Cameroon*

**Preliminary Draft, Please do not cite or circulate without authors' permission*[1]

M. Jimena González Ramírez
Center for Agricultural and Rural Development (CARD)
Iowa State University
majimena@iastate.edu

Niccolo Meriggi
Wageningen University and Research Center
niccolo.meriggi@wur.nl

Selected Paper prepared for presentation at the 2016 Agricultural & Applied Economics Association Annual Meeting, Boston, Massachusetts, July 31-August 2

1. Introduction

Risk is intrinsic to everyone's daily life and many decisions revolve around risk considerations. Economic decisions made by households are no exception; yet, neo-classical economics has failed to capture any dynamics among household members (de Palma et al. 2011, Drichoutis & Koundouri 2012, Carlsson et al. 2013). Expected Utility models treat households as homogenous units with analogous preferences, allocating (scarce) resources to maximize joint welfare (Becker 1974, Chiappori and Meghir 2015). Under the unitary household model, consumption choices are modeled as a constrained utility maximization by a single decision-maker subject to a pooled resource constraint (Becker 1974). This assumption of a unitary household ignores the relative influence each household member has on the decision process and any differences in risk preferences among them. As a result, this unitary household model does not provide an accurate representation of household decisions ignoring, amongst other things, individual spouses' preferences and their relative influence on joint decisions (Carlsson et al. 2012, Sheremenko & Magnan 2015). Given the important influence of household heads and their spouse(s) over the allocation of households' resources, a lack of understanding of between-spouses/intra-household decision making processes may hinder the effectiveness of development policies targeting households' decisions.

In recent years, economists have acknowledged the complexity of intra-household dynamics, developed models taking into account the heterogeneity in preferences of different (key) household members, and therefore gotten closer to an accurate representation/understanding of real world dynamics (Alderman et al. 1995; Bateman and Munro 2003, 2005, 2009; de Palma et al. 2011; Carlsson et al. 2012, 2013; de Brauw and Eozenou 2014; Butle et al. 2015; Castilla 2015; Sheremenko and Magnan 2015). While some of these models study heterogeneity in preferences within households, only some compare individual and joint decisions of spouses (Bateman and Munro 2005, 2009; de Palma et al. 2011; Carlsson et al. 2012, Butle et al. 2015). In reality, intra-household choices are affected by the bargaining power of each spouse

(Sheremenko & Magnan 2015). Understanding female bargaining power is important as studies have observed stronger preferences for child schooling and health outcomes among females (Hoddinott and Haddad 1995, Duflo 2003). Differently, women are less likely to allocate resources towards alcohol or tobacco (Hoddinott and Haddad 1995). Understanding and using these differences in preferences can facilitate the accumulation of human capital and ultimately result in "economic development". Taking into account gender's role in household decisions can therefore help researchers and policy makers design better development programs.

New advances in the literature have penetrated the policy sphere, and they are increasingly raising policy makers' awareness of the importance of intra-households dynamics and gender issues for development effectiveness (Doss 2013). This awareness has motivated increasing efforts to understand: i) the heterogeneity in risk preferences across spouses, which has been found to be gender specific in different contexts, ii) the relative influence of respective preferences on household joint decisions (i.e. bargaining power), and iii) their repercussions on the allocation of resources within a household.

Motivated by the importance of intra-household dynamics and gender issues both for the success of development policies and for the effectiveness of interventions intended to enhance social welfare, we study intra-household differences in risk preferences and their implications on household investment decisions in rural Cameroon. Our study is based on the results from a lab-in-the-field risk experiment in which husband and wife individually participated in isolation and then participated together as a couple. Using the experimental results, we focus on specific differences between spouses, and spouses' individual influence over the couple's joint decision, and answer the following questions: (i) Are there differences in risk preference between husbands and wives within households?; (ii) are there differences in the relative influence of each spouse over joint decisions involving risk?; and (iii) how does this relative influence affect households' expenditure profiles and investment decisions? By investigating these questions, we intend

to enhance the understanding of the dynamics underlying households' investment decisions in less developed countries.

Our results provide evidence of risk aversion among husbands, wives, and couples (i.e. husband and wife together) on average, in which husbands appear to be more risk averse than wives and couples. We find factors influencing the heterogeneity in risk preferences between spouses including whether the wife chose her husband for marriage and whether the wife worked during the past year. For the relative influence of the wife on the couple's joint decision, we find that a wife's choice tends to be closer to the couple's choice within monogamous households relative to polygamous households. Moreover, using a proxy for female bargaining power based on the difference in choices between each spouse and the couple, we find that wives from monogamous households are more likely to have more influence over the joint decision than wives from polygamous households. Lastly, we find that the proxy for female bargaining power is positively correlated with educational and medical expenditures. Our results provide a deeper insight into intra-household dynamics in the studied area, and can be, to some extent, utilized to inform policy and support the generation of more effective development strategies in the region.

2. Literature Review

To better understand household's decisions, experiments have been employed to study intra-household dynamics and gender differences in preferences. While differences in risk preferences is a major component of our paper, it is worth mentioning studies that document other intra-household and gender-specific differences in preferences. For instance, Bateman and Munro (2009) use a choice experiment given to cohabiting couples to study differences between household and individual valuations of dietary health risks. They find significant differences between the values calculated from joint versus individual responses as well as between men and women. Carlsson et al. (2012) study differences in intertemporal choices among households. They analyze the relative influence of husband's and wife's own choices on

their joint decisions and find that in the majority of the households, husbands have stronger influence over joint decisions relative to wives. Castilla (2015), using a trust game among married couples, finds that men return significantly more money than women. However, prior non-cooperation behavior among husbands is associated with less sharing by their wives. Lastly, de Brauw (2015) studies the way women's empowerment affect crop productivity and finds that the ability to make decisions in positively correlated with additional control over family income. These papers illustrate the expansion in the understanding of the heterogeneity in preferences within households that goes beyond differences in risk preferences.

Our study on intra-household and gender differences in risk preferences builds upon existing literature. Bateman and Munro (2005) is one of the first studies that looks at joint decisions among couples. Using experimental data from couples in Norwich, United Kingdom, they conclude that couple's joint choices are typically more risk averse than those made by individuals. Moreover, when studying whether couples' behavior follows the axioms from Expected Utility theory, they find that couples also exhibit the same anomalies observed among individuals. De Palma et al. (2011) use a series of binary choices with a sure amount as the safer choice to estimate both the spouses' and the couple's degrees of risk aversion in Germany. They focus on the dynamics of the decision-making process among couples and conclude that the balance of power is changeable. In most cases, the male partner has more decision-making power at the beginning. However, female partners gain more power over the course of the experiment. They find that the average couple tends to be less risk averse than its average members (de Palma et al. 2011).

Among the different experimental designs, two lab-in-the-field experiments appear to be the most popular methods to elicit risk preferences. Holt and Laury's (2002) multiple price lotteries experiment, in which the payoffs are fixed and the probabilities change in each choice task, has been widely employed to derive risk preferences in the literature (Drichoutis & Koundouri 2012, Carlsson et al. 2013, de Brauw & Eozenou 2014). On the other hand, Tanaka et al. (2010) elicitation method is also commonly used (Tanaka et al. 2010, Sheremenko & Magnan 2015). Their method is different from Holt and Laury's (2002)

as they employ three series of paired lotteries with a total of thirty-five choices that are used to derive three parameters from Prospect Theory (Kahneman & Tversky 1979). Besides the concavity of the utility function that has been used to characterize risk preferences, their method also derives parameters for nonlinear probability weighting loss aversion. Differently from Holt and Laury (2002), they enforce monotonic switching, preventing subjects from switching more than once and enforcing the direction of the switch. Enforcing consistent choices (i.e. a single switching point) could bias the results, as individuals who would behaved inconsistently are kept in the sample (Charness et al. 2013). In essence, if inconsistent choice data is treated as noise and is dropped from the analysis, researchers can be confident that the subjects in the remaining sample understood the instructions and are revealing their true preferences (Charness et al. 2013).

Tanaka et al. (2010) study risk preferences in Vietnamese villages and find that village mean income is correlated with risk and time preferences. However, they do not study intra-household dynamics or gender differences in preferences. Sheremenko & Magnan follow Tanaka et al.'s (2010) elicitation method and study the way experimentally derived risk parameters of individual spouses in farming households affect fertilizer use in Kenya. They also analyze the relation between female bargaining power, risk preferences, and household's agricultural choices and find that more empowered women who are more risk and loss averse apply less fertilizer than disempowered females in collective households.

Our paper utilizes data from a lab-in-the-field experiment that follows Holt and Laury's (2002) elicitation method. The study that is most related to ours is Carlsson et al. (2013), as they study the relation between couple's joint and individual spouses' choices using Holt and Laury's (2002) risk experiment in rural China. They observe that the joint decision is typically closer to the husband's decision and the couple is typically less risk averse than the husband. Moreover, they study the conditions and factors that favor a stronger influence of the wife over the joint decision. For instance, female preferences tend to be better reflected in the joint decision in wealthier households. De Brauw and Eozenou (2014) also follow Holt and Laury

(2002) and design a hypothetical experiment to elicit risk preferences focused on sweet potato production in Mozambique. They use their lab-in-the-field experiment to test different models of risk preferences, and they observe that rank dependent utility dominates expected utility theory. Furthermore, they reject the Constant Relative Risk Aversion (CRRA) hypothesis.

3. The Experiment

3.1 Data Collection and Sample

Our study was conducted in 200 rural villages in the Adamawa region of Cameroon. These villages were randomly selected from a homogeneous sub-population (stratum) of all villages in the region (contained in 2005 census). Between May and July 2013, 3600 households heads residing in the selected villages were administered a questionnaire capturing the living conditions of people in the region. The same group of households were visited again between October and December of 2013 to take part of a sequence of lab-in-the-field experiments measuring individuals' risk preferences and social preferences (i.e. altruism, trust, trustworthiness and distributional preferences). From the 3600 households in the initial sample, 3195 participated in the lab-in-the-field experiments. Given our research questions, we focus on households in which we observe responses for the lab-in-the-field risk preference experiment for the male head of the household, his wife or female partner, and the joint decision. Given this criteria, our sample includes married couples as well as couples living under common law, and it excludes single individuals, widows, widowers, and divorcees. This subset of couples has 1689 households. The following table includes the average of several demographic characteristics.

Table 1 - Summary Statistics:

Variable	Mean
Wife's age	32.62
Husband's age	45.89
Older wife (=1)	0.01
Wife is Muslim (=1)	0.83
Husband is Muslim (=1)	0.84
Monogamous household (=1)	0.52
1st wife in polygamous household (=1)	0.33
Number of wives	1.69
Number of children	5.19
Number of sons	2.72
Number of daughters	2.47
Same ethnicity among spouses (=1)	0.87
Dowry was paid by husband (=1)	0.97
Wife chose husband (=1)	0.32
Wife worked during the year (=1)	0.68
Husband worked during the year (=1)	0.96
Relative welfare[2]	2.85
Wife went to school (=1)	0.28
Husband went to school (=1)	0.4
Husband's expenditure on wife(s)	16.04
Number of observations	**1689**

From Table 1, we observe that husbands[3] are over 10 years older than wives[4] on average. Most of our sample contains husbands and wives who are Muslim, and their religions are highly correlated. Around half of our sample lives in a monogamous household. Amongst polygamous households, the first wife is more likely to be chosen as "game partner' by the male household head. The average number of children per household is around 5, but there is a higher number of sons than daughters on average. The majority of couples belong to the same ethnic group, and the majority of husbands paid a dowry for their wives. Only a third of wives were able to choose their husbands when they got married, as opposed to having a

[2] Based on the following question: In your opinion, what's your household level of welfare relative to others in the village? =1 if much worse, =2 if worse/lower, =3 if the same, =4 if better, and = 5 if much better

[3] For now on, husbands refer to male heads of households, which include married men and men from common law partnerships.

[4] Wives refer to the female partner of the head of the household, and it includes both married women and women living under common law unions.

family member choosing for them. Around 70 percent of wives and 96 percent of husbands worked during the past year. Based on the question about their level of welfare relative to other households in the village, the average response is below the same level category. In other words, the average household reports a slightly lower welfare level than other households in the village. A larger percentage of husbands have attended school relative to wives, but we observe that the majority has not attended any school.

3.2 Experimental Design and Procedure

Risk preferences were measured for the head of the household and (one of)[5] their spouses individually, following the procedure described in Holt and Laury (2002)[6] (See Table 2). At first, respondents (husband and wife) were presented with a sequence of ten paired lotteries individually in isolated locations and asked to decide their favoured option in each lottery over hypothetical gains. Then, participants were brought to the same location and worked through the same lottery choices together. All choices were made with the understanding that one of the choices would be randomly selected as a payoff at the end of the experiment:

[5] For polygamous households, the husband chose a wife to participate in the experiment. Among polygamous households that participated in the lab-in-the-field experiment, we compare wives who were selected by their husband to play the risk game with wives who were not selected. The only major difference we find is age. It appears as if husbands selected older wives on average. However, for the other demographic characteristics, we find no statistically significant differences.

[6] From now on HL2002

Table 2 – Risk game lotteries. XAF stands for the CFA franc, the currency used in Cameroon[7].

Decision	Option A	Option B	Expected Payoff Difference (Option A – Option B)
1	1/10 of 2,000 XAF, 9/10 of 1,600 XAF	1/10 of 3,850 XAF, 9/10 of 100 XAF	XAF 1170
2	2/10 of 2,000 XAF, 8/10 of 1,600 XAF	2/10 of 3,850 XAF, 8/10 of 100 XAF	XAF 830
3	3/10 of 2,000 XAF, 7/10 of 1,600 XAF	3/10 of 3,850 XAF, 7/10 of 100 XAF	XAF 500
4	4/10 of 2,000 XAF, 6/10 of 1,600 XAF	4/10 of 3,850 XAF, 6/10 of 100 XAF	XAF 160
5	5/10 of 2,000 XAF, 5/10 of 1,600 XAF	5/10 of 3,850 XAF, 5/10 of 100 XAF	XAF -180
6	6/10 of 2,000 XAF, 4/10 of 1,600 XAF	6/10 of 3,850 XAF, 4/10 of 100 XAF	XAF -510
7	7/10 of 2,000 XAF, 3/10 of 1,600 XAF	7/10 of 3,850 XAF, 3/10 of 100 XAF	XAF -850
8	8/10 of 2,000 XAF, 2/10 of 1,600 XAF	8/10 of 3,850 XAF, 2/10 of 100 XAF	XAF -1180
9	9/10 of 2,000 XAF, 1/10 of 1,600 XAF	9/10 of 3,850 XAF, 1/10 of 100 XAF	XAF -1152
10	10/10 of 2,000 XAF, 0/10 of 1,600 XAF	10/10 of 3,850 XAF, 0/10 of 100 XAF	XAF -1185

From the lottery decisions, Option A is considered safer than Option B, as the difference in payoffs for each probability is smaller. For both options, payoffs are constant, and probabilities change for each decision. Looking at the expected payoff from each option, a risk neutral individual switches from Option A to Option B after the fourth decision. Individuals who switch to Option B after the fifth decision are considered risk averse and individuals who choose Option B before the fourth decision are considered risk lovers. The later the individual switches to Option B, the more risk averse he or she is. Moreover, for the tenth decision, Option B should be selected, as it clearly has a higher payoff with certainty. Individuals who choose Option A at the tenth decision may or may not have understood the experiment.

3.3 Inconsistent Responses

Before we study intra-household and gender differences in risk preferences, we analyze the quality of the responses from the lab-in-the-field experiment by computing the number of inconsistent responses and by looking at a measurement of the understanding of the experiment. For the former, we compute the number of households with inconsistent responses that arise from two reasons: either the subject chose

[7] HL2002's payoffs were converted to the local currency.

Option A at the tenth lottery or the subject had multiple switching points. The following table summarizes the number of inconsistent responses per group based on both criteria.

Table 3 - Summary of Inconsistent Responses

Group N=1689	Number choosing Option A on 10th lottery	Percentage	Number with Multiple Switching Points	Percentage	Number with both inconsistencies	Percentage
Husbands	248	15.68%	295	17.47%	513	30.37%
Wives	147	8.7%	419	24.81	526	31.14%
Couples	134	7.93%	242	14.33%	362	21.43%
Household*	385	22.79%	685	40.56%	905	53.58%

***either husband, wife or couple has an inconsistent choice**

The percentage of inconsistent responses at the 10th decision for each individual group is comparable to results found in other experiments that range from 6 to 23 percent (de Brauw & Eozenou 2014, Carlsson et al. 2013, de Palma et al. 2011, Bateman & Munro 2005, Holt & Laury 2002). However, once we also remove inconsistent responses based on multiple switching points, we find that the percentage of inconsistent responses is higher relative to other studies. Nonetheless, as we remove households with inconsistent responses for either husband, wife, or couple, we expect to have a higher percentage removed. In fact, Carlsson et al. (2013) observed around 10 percent of inconsistent responses for husbands, wives, and couples separately. However, once they remove inconsistent households, the percentage of inconsistent responses almost doubles to 19 percent. We also observe that once we remove inconsistent responses at the household level, the percentage removed goes from between 21 to 31 percent at each individual group to 54 percent at the household level. Besides looking at the number of inconsistent responses, we also explore participants' understanding by looking at an assessment by the experimenters. After the last decision, each experimenter was asked to assess the understanding of each subject. The evaluation ranged from 1 to 10, with 10 being perfect understanding. For husbands, wives, and couples, the average evaluation are 9.36, 9.27, and 9.43 respectively.

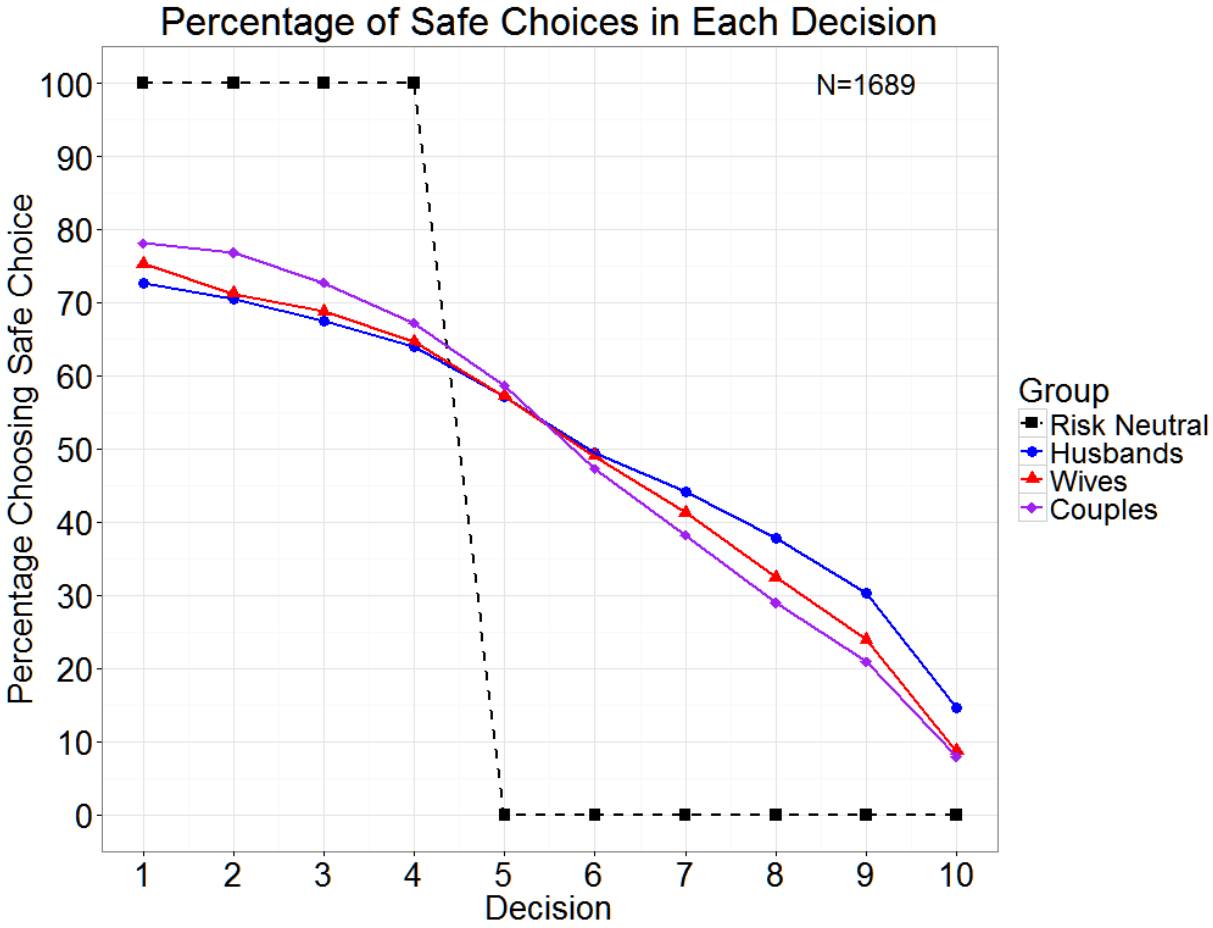
4. Methodology and Results

Using the experiment and the survey, we study the difference in risk preferences between husbands and wives, the relative influence of each spouse on the joint decision, and the way this relative influence affects different household expenditure decisions. Our research strategy consists on studying differences in risk choices at the aggregate level and at the household level. At the aggregate level, we study the proportion of individuals choosing the safe choice and the similarity in responses among different comparison groups at each decision. At the household level, we study factors that affect the similarity of the couple's joint decisions to each spouse's decision separately. We also study characteristics that affect the likelihood that a couple's decision is closer to the husband's decision, the wife's decision, or equally distant from both. Using a proxy for measuring female bargaining power based on individual and joint experimental results, we further study factors that may increase or decrease the wife's relative influence over the joint decision. We conclude our analysis by studying whether this measurement of female bargaining power is correlated with different household expenditure decisions.

4.1 Gender and Intra-household Differences in Risk Preferences using Aggregate Data

Since a risk neutral individual is expected to choose four safe choices, the number of safe choices indicates the degree of risk aversion for each subject, where having more (fewer) than four safe choices implies risk aversion (loving). To study gender and intra-household differences in risk preferences, we illustrate the experimental results with two graphs based on the raw data. Figure 1 depicts the number of safe choices per decision for three groups: husbands, wives, and couples. As a reference, we plot the expected number of safe choices for a risk neutral individual.

Figure 1 - Percentage of Safe Choices in Each Decision



From Figure 1, we observe that husbands, wives, and couples don't respond as risk neutral decision-makers. The black dashed line represents the expected behavior of a risk neutral individual, who is expected to choose the safe choice (Option A) for the first four decisions, and then switch to the risky choice (Option B) from the fifth to the tenth decision. We observe some risk loving individuals to the left of the fourth decision choosing the riskier option[8]. At the first decision, we observe around 73, 75, and 78 percent of husbands, wives, and couples choosing the safe choice. At the fourth choice, we observe around 64, 65, and 67 percent of husbands, wives, and couples choosing the safe choice. Compared to HL2002 and de Brauw & Eozenou (2014), the decreasing proportion of safe choices per decision is also

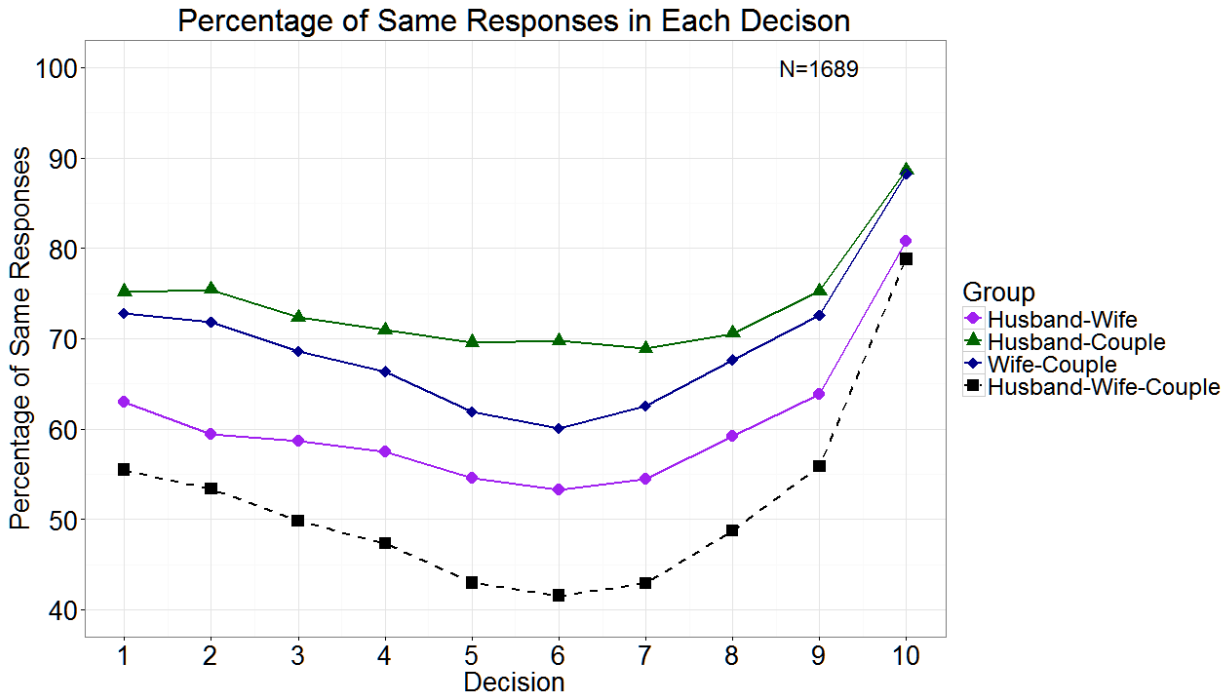
[8] While other studies have also found risk loving individuals, Holt and Laury (2002) and de Brauw and Eozenou (2014) find a higher proportion of safe choices at decisions 1 through 4 ranging from 80 to 90 percent.

observed. However, these studies do not focus on gender and intra-household differences. Concentrating on the different groups, we observe that couples (purple line with diamonds) tend to be closer to risk neutral relative to husbands (blue line with dots) and wives (red line with triangles). In particular, we observe a higher proportion of safe choices among couples during the first four decision and a lower proportion of safe choices after the sixth decision. For the fifth decision, we observe a higher proportion for couples, but the three groups are very close to each other. Moreover, we observe that the three groups tend to be closer to each other between the fourth and sixth decision. We notice a larger proportion of highly risk loving husbands at the first decision and highly risk averse husbands at the 9th and 10th decisions. The line for the proportion of safe choices among wives is between the couples' and husbands' lines[9].

For the second visual illustration, we compare the percentage of identical choices among three comparison groups: i) husbands and wives ii) husbands and couples, iii) wives and couples, and iv) husbands, wives, and couples[10].

[9] We generated a similar figure using the subset of the data that excludes households with inconsistent households (N=784). We observe a similar pattern in which each group doesn't follow risk neutral expectation, and in which we observe more highly risk loving husbands relative to wives and couples.

Figure 2 - Percentage of Same Responses in Each Decision



As de Brauw and Eozenou (2014) explain, similar responses are expected around the tails of the experiment. We observe more similar choices at the end tail of the experiment relative to the beginning of the experiment[11]. As in their experiment, we observe more divergence in choices at the sixth decision for most comparison groups. In particular, we observe around 54[12], 60, and 70 percent of same responses among husband and wife, wife and couple, and husband and couple respectively as depicted by Figure 2. Furthermore, we observe around 42 percent of households with same responses for the husband, wife, and couple at the sixth choice. There are more response matches between husband and couple than for the other comparison groups at each decision. Focusing on the sixth choice, we observe that the husband and couple's choices within a household match 70 percent of the time relative to 60 percent between wife and couple's choices. This difference in percentages suggests that the husband's choice tends to be closer to the couple's choice within a household. There are more matches for the comparison groups

[11] De Brauw & Eozenou (2014) do not see major difference across tails.
[12] De Brauw & Eozenou (2014) find that husband and wife's choices only match 57 percent of the time at the sixth decision.

between the couple and each spouse than for the husband and his wife (green and blue line are above purple line). Moreover, choices diverge the most when we compare the three subjects (i.e the husband, wife, and couple) within each household[13].

Besides the visual representation of the experimental results, we also study the average number of safe choices per group. For inconsistent husbands, wives, or couples, we assign the median[14] between the first and last switch points from Option A to Option B as the switching point for inconsistent subjects, as suggested by Carlsson et al. (2013). The number of safe choices is calculated as the assigned switch point minus one for subjects with inconsistent responses.

Table 4 - Average Number of Safe Choices by Group

Group	**Average Number of Safe Choices**
Husbands	5.02
Wives	4.84
Couples	4.90
N households	1679[15]

From Table 4, the average number of safe choices is higher for husbands (5.02) relative to wives (4.84) and to couples (4.90), as was observed by Carlsson et al. (2013). The average number of safe choices for the joint decision lies between the husbands' and wives' averages, which is also observed by Carlsson et al. (2013)[16]. However, the difference in means seems smaller relative to Carlsson et al. (2013) study. These averages illustrate the existence of risk aversion in the aggregate data. Kolmogorov-Smirnov tow-sided test finds statistically significant difference between the distribution of safe choices between husbands

[13] We generated a similar figure using a subset of the data that excludes households with inconsistent households (N=784). In general, we observe a similar pattern among the four comparison groups lines.
[14] In cases where the median is not a whole number, we round up.
[15] Additional observations are dropped for having missing data on at least one covariate.
[16] Carlsson et al. (2013) study's average number of safe choices are 5.82, 5.39, and 5.65 for Chinese husbands, wives, and couples respectively among consistent choices only. We find that Chinese husbands, wives, and couples appear to be more risk averse relative to our study's results in Cameroon.

and wives with a p-value below 0.001. Since the number of safe choices can be used as a proxy for risk aversion, we also analyze the proportion of subjects with a particular number of safe choices.

Table 5 - Risk Aversion Classification Based on Lottery Choices

	Proportion of Choices (N=1679)		
Number of Safe Choices	**Husbands**	**Wives**	**Couple**
0	0.21	0.16	0.16
1	0.03	0.04	0.04
2	0.04	0.05	0.05
3	0.06	0.07	0.07
4	0.10	0.12	0.12
5	0.11	0.16	0.16
6	0.07	0.10	0.10
7	0.05	0.08	0.08
8	0.06	0.06	0.06
9	0.13	0.11	0.11
10	0.13	0.06	0.06

From Table 5, we observe a large proportion of highly risk loving husbands, wives, and couples, who never chose the safe choice in any of the decisions[17]. Overall, a large proportion of husbands, wives, and couples have between four and six safe choices, which has also been observed in previous studies (HL 2002 and Carlsson et al. 2013). Lastly, we also observe highly risk averse individuals who chose the safe choice nine to ten times[18].

4.2 Gender Differences in Risk Preferences among Spouses

One of the research questions we study is whether there are gender differences in risk preferences among spouses within a household. To address this question, we employ two strategies. Following Carlsson et al.

[17] Other studies find lower proportions of highly risk loving individuals: Holt and Laury (2002) find between 1 and 3 percent of individuals who chose zero to one safe choices. Carlsson et al. (2013) find 2, 9 and 6 percent of husbands, wives, and couples who chose zero to one safe choices. Lastly, de Brauw and Eozenou (2014) find 3 percent of individuals who chose zero safe choices.

[18] Carlsson et al. (2013) observe 25, 17 and 14 percent of husbands, wives, and couples respectively with 9 safe choices. Differently, Holt and Laury (2002) observe between 1 and 6 percent of individuals choosing between 9 and 10 safe choices depending on the payoff. Lastly, de Brauw and Eozenou (2014) observe 10 percent of individuals with 10 safe choices.

(2013), we study the similarity of spouses in individual decisions using a negative binomial model and focusing on the absolute difference in preferences. Secondly, we estimate the likelihood that a wife is more, equally, or less risk averse than her husband using an ordered probit model, incorporating the sign of the difference.

For the first strategy, we estimate a negative binomial model with the absolute difference in safe choices by husband and wife as the dependent variable. For every model, we employ the assigned number of safe choices, calculated based on the median between first and last switch points, for inconsistent subjects. Table 6 summarizes the marginal effects, calculated as the average partial effect and not the partial effect for the average observation, of different factors that might influence the similarity, in absolute value, in risk choices between spouses.

Table 6 - Marginal Effects of Negative Binomial Model for Absolute Difference in Safe Choices between Husband and Wife

Variable	Marginal Effect	P-Value
Wife's age	0.017	0.0705*
Husband's age	-0.004	0.6248
Older wife (=1)	-0.328	0.6059
Husband is Muslim (=1)	0.598	0.2465
Monogamous hhold (=1)	0.372	0.4268
If polygamous and 1st wife (=1)	-0.256	0.2432
Number of wives	-0.149	0.3351
Number of children	-0.006	0.7615
Same ethnicity among spouses (=1)	-0.155	0.4648
Wife chose husband (=1)	-0.454	0.0025***
Wife worked during the year (=1)	-0.046	0.7617
Relative welfare	-0.017	0.8414
Wife went to school (=1)	0.001	0.3556
Husband went to school (=1)	0.067	0.7325
Husband's expenditure on wife(s)	0.509	0.3169
Muslim Husband * Husband with any schooling	-0.698	0.1306
Muslim Husband * Monogamous	-0.599	0.1573

*** p-value <0.01, ** p-value<0.05,* p-value<0.01
Robust standard errors are estimated.
Number of Observations = 1679

From Table 6, couples with older wives are more likely to have a larger absolute difference in safe choices than couples with younger wives on average. However, the size of this marginal effect is very small. Wives who reported that they chose their husbands for marriage, as opposed of having any family member choosing for them, are more likely to have similar choices to their husbands. The absolute difference in safe choices decreases by half a point for wives who chose their husbands on average. The decision power in the marriage process could favor the match of more similar spouses, which could explain the sign and significance of this marginal effect.

For the second strategy, we assign each couple to three categories based on their difference in risk preferences: (1) wife is less risk averse than her husband, (2) wife is equally risk averse as her husband, and (3) wife is more risk averse than her husband[19]. Each category is assigned based on the difference in number of safe choices, where having a higher number of safe choices implies more risk aversion. We observe 753, 241, and 685 in each category respectively. We estimate an ordered probit model with the constructed categories as the dependent variable. We find that the predicted probability of a wife being less, equally, more risk averse than her husband is around 45, 14, and 41 percent respectively. Hence, we observe heterogeneity in risk preferences among husbands and wives, as the majority of wives are predicted to be either more or less, but not equally risk averse to their husbands. Table 7 reports the marginal effects for the ordered probit regression[20]. For dummy variables, the marginal effect is computed as the discrete change of the variable from 0 to 1.

[19] Without loss of generality, we employ comparisons with the wife as a reference.
[20] An ordered logit model yields similar results.

Table 7 - Marginal effects of Ordered Probit Regression on Gender Differences in Risk Preferences among Spouses

	Marginal Effects		
	Wife less risk averse than husband	**Wife equally risk averse as husband**	**Wife more Risk Averse than Husband**
Wife's age	-0.0003	0.0000	0.0003
Husband's age	-0.0010	0.0000	0.0010
Older wife (=1)	-0.0234	0.0002	0.0232
Husband is Muslim (=1)	0.1405	0.0037	-0.1443
Monogamous hhold (=1)	0.0429	-0.0008	-0.0421
Number of wives	0.0261	-0.0005	-0.0256
Number of children	-0.0043	0.0001	0.0042
Same ethnicity among spouses (=1)	-0.0305	0.0009	0.0297
Wife chose husband (=1)	-0.0079	0.0001	0.0078
Wife worked during the year (=1)	0.0734**	-0.0005	-0.0729**
Husband worked during the year (=1)	-0.0096	0.0002	0.0094
Relative welfare	0.0036	-0.0001	-0.0035
Wife went to school (=1)	-0.0123	0.0002	0.0121
Husband went to school (=1)	0.1771*	-0.0059	-0.1711*
Husband's expenditure on wife(s)	0.0000	0.0000	0.0000
Muslim Husband * Husband with any schooling	-0.1665*	-0.0031	0.1695*
Muslim Husband * Monogamous	-0.0208	0.0003	0.0205

*** p-value <0.01, ** p-value<0.05,* p-value<0.01
Robust standard errors are estimated.
Number of Observations = 1679

From Table 7, we notice that there are three variables that influence the likelihood of having heterogeneous preferences among spouses (i.e. of being in the first and last category). Whether the wife worked during the last year increases the heterogeneity in risk preferences among spouses in a statistically significant way. If a wife has worked in the past year, the probability of the wife being more risk averse than her husband decreases by around 7 percent and goes from 41 to 34 percent. Analogously, a wife who worked in the past year is more likely to be have a more risk averse husband than a wife who did not participate. Labor force participation for the wife appears to contribute to some heterogeneity in risk preferences between spouses. Taking into account that the majority of our sample of husbands and wives did not receive any schooling, whether the husband attended school also appears to contribute to

differences in risk preferences between spouses. A husband with any schooling appears more likely to be with a less risk averse wife. Nonetheless, once we additionally control for the husband's religion, we find that a Muslim husband with schooling seems less likely to be with a less risk averse wife than a non-Muslim husband with schooling.

From the two strategies in this section, we find different factors correlated with heterogeneity in risk preferences among spouses. From the first model, we find factors affecting the similarity of risk preferences among couples in absolute value. For the second model, we find factors that affect whether one spouse is more or less risk averse than the other, incorporating a direction in the difference in risk preferences compared to the first model. More research is required to understand heterogeneity in risk preferences among spouses.

4.3 Similarity of Each Spouse's Individual Decision to the Couple's Joint Decision

Given our unique dataset containing individual and joint responses, we study the similarity of each spouse's individual decisions to the joint couple's decision. We compare the number of safe choices, as a proxy for the degree of risk preferences, chosen by the couple to the number of safe choices chosen by the husband and by the wife in two ways. First, we compute the absolute difference in safe choices among the following comparison groups: husband versus couple and wife versus couple. If this difference is very small between husband (wife) and couple, we interpret it as the husband (wife) having more similar risk preferences as the couple. We study these absolute differences to analyze possible characteristics that might make the husband's (wife's) and the couple's decisions more similar.

Table 8 – Absolute Difference in Safe Choices

Absolute Difference in Safe Choices between:	Min	Mean	Max	Standard Deviation
Husband and Couple	0	2.37	10	2.51
Wife and Couple	0	2.64	10	2.44
Husband and Wife	0	3.49	10	2.83

From the Table 8, the average absolute difference in safe choices is smaller between husband and couple than between wife and couple or between husband and wife. While we concentrate on the first two comparisons, we report the average absolute difference in safe choices between husband and wife to contrast the heterogeneity in risk preferences between spouses to the heterogeneity between individual and joint choices.

Following Carlsson et al. (2013)[21], we estimate a negative binomial model with the absolute difference in safe choices as a dependent variable. Tables 9 and 10 report marginal effects from the negative binomial regression that are calculated as the average partial effects and not the partial effect for the average observation. For dummy variables, the marginal effect is computed as the discrete change of the variable from 0 to 1.

[21] Carlsson et al. (2013) use a negative binomial regression on the absolute difference in safe choices between husbands and wives as they study heterogeneity in preferences between husband and wife. For this section, we focus on the similarity of decisions between each spouse and the couple.

Table 9 – Marginal Effects of Negative Binomial Model for Absolute Difference in Safe Choices between Husband and Couple

Variable	Marginal Effect	P-Value
Wife's age	0.012	0.1472
Husband's age	-0.004	0.5540
Older wife (=1)	0.842	0.2032
Husband is Muslim (=1)	0.576	0.1531
Monogamous household (=1)	0.117	0.7909
1st wife in Polygamous household (=1)	-0.538	0.0028***
Number of wives	-0.309	0.0283**
Number of children	0.015	0.4159
Same ethnicity among spouses (=1)	-0.344	0.0913*
Wife chose husband (=1)	-0.164	0.2225
Wife worked during the year	0.059	0.6662
Relative welfare	-0.075	0.3044
Husband's expenditure on wife(s)	0.000	0.6713
Wife went to school (=1)	0.050	0.7597
Husband went to school (=1)	-0.110	0.7724
Muslim Husband * Husband with any schooling	-0.165	0.6703
Muslim Husband * Monogamous	-0.750	0.0669*

*** p-value <0.01, ** p-value<0.05,* p-value<0.01
Robust standard errors are estimated.
Number of Observations = 1679

Among polygamous households, the order of marriage seems to influence the similarity in safe choices between husband and couple. The survey asked polygamous wives whether they are the first, second, third, or so on wife. Husbands who participated in the experiment with their first wives tend to have a lower absolute difference in safe choices with the couple. In other words, husbands tend to have more influence over the joint decision when playing with their first wives than with their second, third, fourth, or fifth wives. Husbands with more wives tend be more similar to the couple, suggesting more influence over the couple's choice. Being from the same ethnic group also increases the similarity in safe choices between husband and couple. While monogamous status does not have a marginal effect that is statistically significant, a monogamous Muslim husband tends to have more similar responses to the couple than a monogamous non-Muslim husband.

Table 10 - Marginal Effects of Negative Binomial Model for Absolute Difference in Safe Choices between Wife and Couple

Variable	Marginal Effect	P-Value
Wife's age	0.008	0.3230
Husband's age	0.001	0.9329
Older wife (=1)	-0.203	0.7209
Husband is Muslim (=1)	0.116	0.7976
Monogamous household (=1)	-0.629	0.1352
1st wife in Polygamous household (=1)	0.094	0.6243
Number of wives	-0.159	0.2231
Number of children	-0.022	0.2027
Same ethnicity among spouses (=1)	-0.049	0.7987
Wife chose husband (=1)	-0.001	0.9915
Wife worked during the year	0.099	0.4404
Relative welfare	0.067	0.3588
Husband's expenditure on wife(s)	0.001	0.1914
Wife went to school (=1)	0.022	0.8974
Husband went to school (=1)	0.364	0.3921
Muslim Husband * Husband with any schooling	-0.589	0.1274
Muslim Husband * Monogamous	0.641	0.1266

*** p-value <0.01, ** p-value<0.05,* p-value<0.01
Robust standard errors are estimated.
Number of Observations =1679

From Table 10, we find no statistically significant marginal effects that make the wife's choice closer to the couple's choice.

4.4 The Relative Influence of Each Spouse on the Couple's Joint Decision

Besides analyzing the similarity between the husband's (wife's) and the couple's decisions, we now study the way each spouse influences the joint decision in an attempt to understand which spouse's risk preferences are better captured in the couple's joint decision. Following Carlsson et al. (2013), we categorize each household based on the similarity in the number of safe choices: (1) couple is closer to husband, (2) couple is equally distant from husband and wife, and (3) couple is closer to wife. We estimate an ordered probit model to study factors that influence the likelihood to fall into one of these three categories. We compute the predicted probabilities for each category.

Table 11 - Predicted Probabilities of Joint Influence

Category	Average Predicted Probability
Couple closer to husband	0.43
Equal Distance	0.20
Couple closer to wife	0.36

From Table 11, we observe that a couple's joint decision is more likely to be influenced by the husband than by the wife. Furthermore, having equal influence on the joint decision is even less likely. The marginal effects of the ordered probit[22] regression are presented in Table 12.

Table 12 – Marginal Effects of Ordered Probit Regression of Spouses' Influence on Joint Decision

	Marginal Effects		
Variable	**Couple closer to husband**	**Equal Distance**	**Couple closer to wife**
Wife's age	-0.001	0.000	0.001
Husband's age	0.000	0.000	0.000
Older wife (=1)	-0.038	0.001	0.037
Husband is Muslim (=1)	-0.042	0.003	0.039
Monogamous household (=1)	-0.130*	0.006	0.123*
Number of wives	-0.006	0.000	0.006
Number of children	-0.003	0.000	0.003
Same ethnicity among spouses (=1)	0.023	-0.001	-0.022
Wife chose husband (=1)	0.035	-0.002	-0.033
Wife worked during the year	0.016	-0.001	-0.015
Relative welfare	0.019	-0.001	-0.018
Wife went to school (=1)	0.033	-0.002	-0.031
Husband went to school (=1)	-0.025	0.001	0.024
Husband's expenditure on wife(s)	0.000	0.000	0.000
Muslim Husband * Husband with any schooling	-0.011	0.001	0.011
Muslim Husband * Monogamous	0.127*	-0.008	-0.119*

*** p-value <0.01, ** p-value<0.05,* p-value<0.01
Number of Observations = 1679

[22] An ordered logit regression was also estimated obtaining very similar results.

From Table 12, two variables influence the likelihood that the couple is closer to the husband. On one hand, monogamous husbands are less likely to be closer to the couple relative to polygamous husbands, in which the predicted probability of being in this category decreases from 43 to about 30 percent. However, once we consider some interactions, we find that Muslim monogamous husbands are 13 percent more likely to be closer to the couple than non-Muslim monogamous husbands. Moreover, these same factors influence the likelihood that the couple's joint decision is closer to the wife's, but in the opposite direction. For instance, monogamous wives are around 12 percent more likely to be closer to the couple than polygamous wives. However, monogamous wives married to Muslim husbands are 22 percent less likely to be closer to the couple relative to monogamous wives married to non-Muslim husbands.

While these three categories inform us on who has more influence, we expand the understanding of the relative influence of each spouse on the joint couple's decision by using a proxy for bargaining power. We construct this proxy using the following formula:

$$female\ barg = \left(\frac{|S_{husband} - S_{couple}|}{10} - \frac{|S_{wife} - S_{couple}|}{10} \right)$$

Where S =Number of safe choices by husband, wife, or couple. We look at the absolute difference in safe choices for each comparison group, and we divide by the maximum number of safe choices possible. Notice that *female barg* takes the value of 1 if the husband is as different from the couple and there is no difference in safe choices between wife and couple (i.e. wife is the same as couple). Furthermore, *female barg* is zero when both spouses have the same influence over the couple's decision and their difference in safe choices is equal. Lastly, *female barg* takes the value of -1 if the husband had identical choices as the couple, and the wife is as different to the couple as possible. With this definition, a positive *female barg* implies that the wife has more influence over the couple's choice, and a negative *female barg* implies that the husband is more influential. We then normalize *female barg* such that if falls between 0 and 1.

After this normalization, we observe that the average *female barg* is 0.49 and the median is 0.5, the point where both have equal influence over the joint profile. With the female bargaining power measure constructed, we assign ordered categories depending on the wife's influence level over the joint couple's decision, or female bargaining power:

Table 13 – Female Bargaining Power Levels

Category	**1**	**2**	**3**	**4**	**5**	**6**	**7**
***female barg*'s range**	0	(0,0.25]	(0.25,0.5)	0.5	(0.5,0.75]	(0.75,1)	1
Female bargaining power measure	Least influence over couple's decision	Less influence than husband	Less influence than husband	Same influence as husband	More influence than husband	More influence than husband	Most Influence over couple's decision
Observations	21	147	560	340	535	66	10
Predicted Probability	0.01	0.09	0.33	0.20	0.32	0.04	0.01

We estimate an ordered probit with the categories as the dependent variable. The predicted probabilities are summarize in Table 12, which suggest that it more likely for wives to have less influence over the joint decision than husbands than to have more influence. Table 14 summarizes the marginal effects from the model:

Table 14 – Marginal Effects of Ordered Probit of Female Bargaining Power Measure

	Marginal Effects						
Variable	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Wife's age	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Husband's age	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Older wife (=1)	-0.01*	-0.04	-0.07	0.00	0.08	0.03	0.01
Husband is Muslim (=1)	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Monogamous household (=1)	-0.01*	-0.05**	-0.07**	0.01*	0.10**	0.03*	0.01*
Number of wives	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Number of children	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Same ethnicity among spouses (=1)	0.00	0.01	0.01	0.00	-0.02	0.00	0.00
Wife chose husband (=1)	0.00	0.01	0.01	0.00	-0.02	-0.01	0.00
Wife worked during the year (=1)	0.00	0.00	0.01	0.00	-0.01	0.00	0.00
Relative welfare	0.00	0.01	0.01	0.00	-0.01	0.00	0.00
Wife went to school (=1)	0.00	0.00	0.01	0.00	-0.01	0.00	0.00
Husband went to school (=1)	0.01	0.03	0.04	0.00	-0.05	-0.01	0.00
Husband's expenditure on wife(s)	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Muslim Husband * Husband with any school	-0.01	-0.03	-0.05	0.00	0.06	0.02	0.00
Muslim Husband * Monogamous	0.01*	0.05**	0.08**	-0.01	-0.10**	-0.03**	-0.01*

*** p-value <0.01, ** p-value<0.05,* p-value<0.01
Number of Observations = 1679

From Table 14, monogamous status influences the likelihood of falling into each category. Wives from monogamous households are more likely to have more influence over the joint decision than wives from polygamous households. The probability of falling into the categories with less influence (i.e. categories 1, 2, and 3) decreases for monogamous wives. At the same time, the probability of falling into the categories with more influence (i.e.5, 6, and 7) increases for monogamous wives, which is consistent with the findings from Table 12. However, the marginal effects vary in size per category, with larger effects for categories three and five. These two categories fall next to the category for equal influence from both spouses, which has a very small, but positive marginal effect. Monogamous wives are more likely to have the same influence over the couple's decision relative to wives, and the predicted probability of falling

within this equally influence category increases from 20 to 21 percent. Once we consider monogamous status and religion together, we find that that wives are more likely to have less influence over the joint decision within monogamous households with Muslim husbands relative to wives within monogamous households with non-Muslim husbands. With this model, we observe larger marginal effects around the equally influence category, which has a small marginal effect that is not statistically significant. Seeing the different sizes of the marginal effects for each category confirms the importance of using these different categories. With this model, we are able capture different marginal effects sizes for each category that go beyond simply identifying which spouse has more influence over the joint decision.

4.5 The Relation between Wife's Relative Influence on Couple's decision and Household Expenditure Decisions.

Our last research question is focused on understanding the way female bargaining power, measured as the wife's relative influence over the joint decision, affects different expenditure decisions including annual expenditure on education and on medical related goods. Focusing on expenditure on education, the survey includes questions about annual expenditures on tuition, school registration, books, newspapers, notebooks, or other expenses related to education. We use answers to these questions and construct an annual education expenditure variable. We estimate a linear regression with the latter as the dependent variable, and we include *female barg* as an explanatory variable, among others. Table 15 summarizes results from the regression:

Table 15 – Linear Regression on Annual Expenditure on Education

Variable	Coefficient	Robust Std. Error	P-value
female barg	27527	16187	0.0910*
Wife's age	253	190	0.1840
Husband's age	425	189	0.0260**
Husband is Muslim (=1)	-22906	15212	0.1340
Monogamous hhold (=1)	-8684	11026	0.4320
Number of wives	-6602	3363	0.0510*
Number of sons	4568	1341	0.0010***
Number of daughters	2154	1065	0.0440**
Number of grandparents	-2555	3937	0.5170
Relative welfare	10867	4649	0.0200**
Wife worked during the year (=1)	-2041	3861	0.5980
Husband worked during the year (=1)	-3439	6839	0.6160
Wife went to school (=1)	23640	8162	0.0040***
Husband went to school (=1)	-120	10427	0.9910
Wife's subjective health	-2210	3541	0.5330
Husband's subjective health	2415	5273	0.6470
Intercept	-34061	44714	0.4470

N=1679
Clustered standard errors at village level
*** p-value <0.01, ** p-value<0.05,* p-value<0.01
R-squared=0.06

From Table 15, our proxy for female bargaining power is positively correlated with educational expenditure, suggesting that households with wives with more influence over the couple tend to spend more on education on average. This result confirms the importance of understanding the relative influence each wife has on the intra-household decision-making process. Households with older husbands appear to invest more on education in a year on average, but the size of the coefficient is small. We control for the size of the household by including number of wives, sons, daughters, and grandparents who live in the households. While the number of wives is negatively correlated with annual educational expenditure, the number of sons and daughters are positively correlated. Households with more sons and with more daughters tend to invest more on education than households with fewer sons and fewer

daughters respectively on average. The size of the coefficient is larger for number of sons than number of daughters. Households with higher perceived level of welfare relative to other households in their villages also tend to invest more on education. Lastly, households with wives who went to school tend to spend more on education than households with uneducated wives.

For annual medical expenditures, the field survey includes questions about semi-annual expenditures on medicines, drugs, hygiene articles, and body-care products and about annual expenditures on examination, care, and hospital fees. We construct an annual medical expenditure variable with the answers to the former questions, and we estimate a linear regression model. Results from the regression are summarized in Table 16:

Table 16 – Linear Regression on Annual Medical Expenditure

Variable	**Coefficient**	**Robust Std. Error**	**P-value**
female barg	49462	24569	0.0450**
Wife's age	-608	474	0.2010
Husband's age	317	428	0.4600
Husband is Muslim (=1)	11674	17528	0.5060
Monogamous hhold (=1)	-7398	19275	0.7020
Number of wives	758	11341	0.9470
Number of sons	5400	2490	0.0310**
Number of daughters	6127	2861	0.0330**
Number of grandparents	8527	15963	0.5940
Relative welfare	10120	7525	0.1800
Wife worked during the year (=1)	11193	9582	0.2440
Husband worked during the year (=1)	1762	18925	0.9260
Wife went to school (=1)	21959	12648	0.0840*
Husband went to school (=1)	-17644	13662	0.1980
Wife's subjective health	2880	8568	0.7370
Husband's subjective health	12559	9862	0.2040
Intercept	-51176	65884	0.4380

N=1679
Clustered standard errors at village level (196 clusters)
*** p-value <0.01, ** p-value<0.05,* p-value<0.01
R-squared=0.03

As with education, our proxy for female bargaining power is positively correlated with annual medical expenditures. The more influence a wife has on the couple's decision, the more medical expenditure her household has on average after controlling for other factors such as number of households members. Both number or sons and daughters are also positively correlated with medical expenditure, but the estimated coefficient for number of daughters is larger. We control for both husband's and wife's subjective health status, but we find no statistically significance for these variables. Lastly, households with wives who attended school also tend to spend more on medicines and hygiene products relative to households with uneducated wives on average.

5. Conclusions

Given the importance of intra-household dynamics for the success of development policies, we study heterogeneity in risk preferences between husband and wife within a household, the relative influence of each spouse on joint decisions involving risk, and the way this relative influence affects annual educational and medical expenditures within a household using a lab-in-the-field risk experiment. Focusing on the aggregate data, we observe risk aversion in husbands, wives, and couples, in which husbands are observed to be more risk averse than wives, and couples on average. Focusing on the percentage of same choices at each decision in the experiment, we find more matches between husband and couple than between wife and couple, suggesting more influence of husbands over couples' decisions.

At the household level, we find heterogeneity in risk preferences between husband and wife within a household. A wife who chose her husband for marriage tends to have more similar risk preferences, in absolute terms and on average, as her husband relative to a wife who did not chose. Moreover, we find characteristics that affect whether one spouse is more, equally, or less risk averse than the other,

incorporating a direction in the difference in risk preferences. A working wife is less likely to be more risk averse than her husband relative to a non-working wife on average.

To study the relative influence of each spouse on joint decisions involving risk, we use individual and joint experimental decisions. We find that monogamous husbands are less likely to be closer to the couple relative to polygamous husbands, and that monogamous wives are more likely to be closer to the couple than polygamous wives on average. To study female bargaining power, we construct a proxy measure using the differences in individual and joint choices. Using this measure, we find that wives from monogamous households are more likely to have more influence over the joint decision than wives from polygamous households.

Lastly, we explore the way this proxy for female bargaining power affects annual educational and medical expenditures. We find that households with wives that have more bargaining power tend to invest more on education than households with wives that less bargaining power. At the same time, the more influence a wife has on the couple's decision, the more medical expenditure her household has on average, controlling for number of household members and subjective health statuses. Our findings reaffirm the importance of understanding intra-household dynamics and the relative influence of each spouse on joint decisions, as they can influence different expenditure decisions associated with development strategies.

References

Alderman, H., Chiappori, P. A., Haddad, L., Hoddinott, J., & Kanbur, R. (1995). Unitary versus collective models of the household - is it time to shift the burden of proof? *The World Bank Research Observer, 10*(1), 1-19.

Bateman, I. J., & Munro, A. (2003). Testing economic models of the household: an experiment. *CSERGE working paper, University of East Anglia, Norwich*.

Bateman, I. J., & Munro, A. (2009). Household Versus Individual Valuation: What's the Difference? *Environmental Resource Economics, 43*, 119-135.

Bateman, I., & Munro, A. (2005, March). An Experiment on Risk Choice Amongst Households. *The Economic Journal*, C176-C189.

Becker, G. S. (1974). A theory of social interactions. *Journal of Political Economy, 82*(6), 1063-1093.

Bergstrom, T., Blume, L., & Varian, H. (1986). On the Private Provision of Public Goods. *Journal of Public Economics, 29*(1), 25-49.

Butle, E., Tu, Q., & List, J. (2015). Battle of the Sexes: How Sex Ratios Affect Female Bargaining Power. *Economic Development and Cultural Change, 64*(1).

Cardenas, J. C. (2009). Experiments in Environment and Development . *Annual Review of Resource Economics* , 157-182.

Carlsson, F., He, H., Martinsson, P., Qin, P., & Sutter, M. (2012). Household decision making in rural China: Using experiments to estimate the influence of spouses. *Journal of Economic Behavior & Organization, 84*, 525-536.

Carlsson, F., Martinsson, P., Qin, P., & Sutter, M. (2013). The Influence of Spouses on Household Decision Making under Risk: an Experiment in Rural China. *Experimental Economics*, 383-401.

Castilla, C. (2015). Trust and Reciprocity between Spouses in India. *American Economic Review: Papers & Proceedings, 105*(5), 621-624.

Charness, G., Gneezy, U., & Imas, A. (2013). Experimental methods: eliciting risk preferences. *Journal of Economic Behavior & Organization, 87*, 43-51.

Chiapporri, P.-A., & Meghir, C. (2015). Chapter 16 - Intrahousehold Inequality. In A. B. Atkinson, & F. Bourguignon (Eds.), *Handbook of Income Distribution* (Vol. 2, pp. 1369-1418).

de Brauw, A. (2015). Gender, control, and crop choice in northern Mozambique. *Agricultural Economics, 46*, 435-448.

deBrauw, A., & Eozenou, P. (2014). Measuring Risk Attitudes among Mozambican Farmers. *Journal of Development Economics, 11*, 61-74.

Doss, C. (2013, February). Intrahousehold Bargaining and Resource Allocation in Developing Countries. *World Bank Research Observer, 28*(1), 52-78.

Drichoutis, A. C., & Koundouri, P. (2012). Estimating Risk Attitudes in Conventional and Artefactual Lab Experiments: The importance of the underlying assumptions. *Economics: The Open-Access, Open Assessment E-Journal*, 1-15. Retrieved from http://dx.doi.org/10.5018/economics-ejournal.ja.2012-38

Duflo, E. (2003). Grandmothers and granddaughters: old age pension and intra-household allocation in South Africa. *World Bank Economic Review, 17*, 1-25.

Harrison, G., Humphrey, S., & Verschoor, A. (2010, March). Choice under Uncertainty: Evidence from Ethiopia, India, and Uganda. *The Economic Journal, 120*, 80-104.

Hoddinott, J., & Haddad, L. (n.d.). Does female income share influence household expenditures? Evidence from Cote d'Ivoire. *Oxford Bulletin of Economics and Statistics, 57*, 77-96.

Holt, C. A., & Laury, S. K. (2002, December). Risk Aversion and Incentive Effects. *American Economic Review, 92*(5), 1644-1655.

Kahneman, D., & Tversky, A. (1979). Prospect Theory: An Analysis of Decision Under Risk. *Econometrica, 47*(2), 263-291.

Liu, E. M. (2013). Time to Change What to Sow: Risk Preferences and Technology Adoption Decisions of Cottom Farmers in China. *The Review of Economics and Statistics, 95*(4), 1386-1403.

Sheremenko, G., & Magnan, N. (2015). Gender-specific Risk Preferences and Fertilizer Use in Kenyan Farming Households. *AAEA and WAEA Annual Meeting.* San Francisco.

Tanaka, T., Camerer, C. F., & Nguyen, Q. (2010). Risk and Time Preferences: Linking Experimental and Household Survey Data From Vietnam. *American Economics Review, 100*(1), 557-571.

World Bank. (2011). *World Development Report 2012: Gender Equality and Development.* Washington, DC, USA: Work Bank.