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Intra-household efficiency:

An experimental study from Ethiopia[1]

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Abstract: Using data from experimental games and household survey from 1,200 married couples in three sites in Ethiopia, this paper uses different versions of a voluntary contribution mechanism to test for household efficiency. The experimental and econometric analyses provide many interesting results that have far-reaching implications for intra-household models. Efficiency in contribution behaviour is decisively rejected in all treatments casting doubt on 'unitary' and 'collective' household models that assume Pareto optimality – significant amounts of potential surplus are not realised. Contribution rates by males and females are not significantly different from each other undermining models that argue females tend to contribute more to the family (for example, Sen 1990). Information on initial endowments of spouses improves contribution rates (efficiency) in some treatments while not having effect in others suggesting that the effect of information is context dependent. Actual and expected contribution rates of spouses are systematically different; husbands' expect their wives will contribute more than their actual contributions and wives expect their husbands will contribute lower than their actual contribution. These systematic errors in expectations imply that the attainment of equilibrium in a game

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1

theoretic framework is unlikely. Statistical tests indicate that instead of efficiency considerations other norms are likely important. For example, in many of the treatments spouses contributed around half of their endowments implying either a norm like fairness or focal points influence decisions. Overall, most of the empirical results cast doubt on cooperative models and provide some support for behaviour guided either by fairness or other norms.

JEL classification: D13, C93, D03

Key words: household efficiency; intra-household models; experimental games; Ethiopia

1. Introduction

The family is one of the most enduring and universal institutions in human societies spanning vast expanses of historical time and geographical space. In spite of that, the systematic study of resource allocation and individual welfare within households in economics is a relatively recent phenomenon. Starting from the seminal works of Becker (Becker 1965; Becker 1973; Becker 1974; Becker 1974; Becker 1991) the intra-household literature has come a long way. Using Nash bargaining Manser and Brown (1980) and McElroy and Horney (1981) developed highly influential models of household decision making that explicitly take individual preferences into account showing household income changes can have differential impacts (for example, on household demand) depending on the 'bargaining power' of the spouses. Instead of assuming specific bargaining framework within the household, 'collective' models start from the assumption of Pareto efficiency and analyse its implications on intra-household allocations (Chiappori 1988; Chiappori 1992; Lundberg and Pollak 1993; Chiappori 1997; Chiappori 1997; Chiappori, Fortin et al. 1998; Apps and Rees 2007; Blundell, Chiappori et al. 2007; Chiappori, Iyigun et al. 2009). The characteristic feature of all these household models is the assumption of efficiency – households realise all potential surplus. In contrast, in non-cooperative household models households may fail to attain efficiency (Lundberg and Pollak 1994; Lechene and Preston 2008; Browning, Chiappori et al. 2009). A highly influential empirical paper by Chris Udry (1996) showed that this is actually so in West African agricultural households where allocation of inputs on plots owned by wives and husbands is highly inefficient.

Apart from the dominant models in economics mentioned above, intra-household models that focus on other considerations have also been developed. For example, Farmer and Tiefenthaler (1995) present a model where the intra-household investment on children is mainly determined by parental preferences for equity which depend on fairness. Antonides and Kroft (2005) show that asymmetries in the valuation of losses compared to foregone gains affect spouses' fairness judgements.

The use of experimental games to analyse intra-household issues is recently on the increase. For example, Ashraf (2009) looks at the effect of observability and communication on financial choices of married couples in

the Philippines. With observability individuals are more willing to deposit their money in the account of their spouse; but this effect is strongly mediated by underlying control power rather than being determined by gender. Mani (2010) showed that spouses from India are willing to sacrifice efficiency for the sake of controlling household resources. Spiteful and self-destructive behaviour by spouses can be explained better by factors like identify than the usual explanations in the dominant household models.

This paper mainly examines whether efficiency is attained among married couples by using experimental games that use variations of a voluntary contribution mechanism. In this simple framework, efficiency is defined as full contribution of all endowments into a common pool. In addition to testing for efficiency, the different experimental treatments also enable to examine many issues related to intra-household allocations. For example: differences in contribution rates of males and females, between regions; the effect of information; the difference between actual and expected behaviour of spouses which shades light on equilibrium attainment in a game theoretic framework.

The experimental games were conducted with 1,200 married couples in three sites in Ethiopia, one urban and two rural, to capture some of the crucial variations in the country in terms of the urban-rural divide, ethnic composition and different farming systems. The experimental and econometric analyses provide many interesting results that have far-reaching implications for intra-household models. The attainment of efficiency is decisively rejected in all treatments casting doubt on 'unitary' and 'collective' household models that assume Pareto optimality – significant amounts of potential surplus are not realised. Contribution rates by males and females are not significantly different from each other undermining models that argue females tend to contribute more to the family (for example, Sen 1990). Information on initial endowments of spouses improves contribution rates (efficiency) in some treatments while not having effect in others suggesting that the effect of information is context dependent. Actual and expected contribution rates of spouses are systematically different; husbands' expectations of their wives' contributions is higher than actual contributions and wives' expectations of their husbands' contributions are lower than actual contribution. These systematic errors in expected and actual behaviour indicate that the attainment of equilibrium in a game theoretic framework is unlikely. Statistical tests indicate that instead of efficiency considerations other norms are likely important. For example, in many of the treatments spouses contributed around half of their endowments implying either norm like fairness or focal points influence decisions. Overall, most of the empirical results cast doubt on cooperative models and provide some support for behaviour guided either by fairness or other forms of norms.

The rest of the paper is organised in the following way. The next two sections present the experimental design and the fieldwork for data collection. After discussing the main experimental results in Section 4, econometric analysis of the correlation between contribution behaviour and household socio-economic characteristics is examined in Section 5. The final section presents concluding remarks.

2. Experimental design

Nineteen treatments were played in Ethiopia capturing the effect of differences in endowments, control of allocation, information and 'production'. Fourteen are variations of a voluntary contribution experiment and five of a 'production' experiment.

The following three treatments were implemented in all the three sites:

1.   Investment baseline (treatment 1): Each spouse separately and privately receives an endowment of Birr 40. Each person then chooses an investment from the set (0, 10, 20, 30, 40). The investments of the 2 spouses are summed and multiplied by 1.5 and then each player receives half of the total.

2.   Female control (treatment 6) – Like the investment baseline except that the allocation of the common pool is now decided by wives; they can take any amount of the common pool and leave the rest to their husbands.

3.   Male control (treatment 7) – Like female control except that husbands control the allocation of the common pool.

In treatment 2 (*all to men*) each subject separately and privately receives Birr 40 and makes an investment decision from the same choice set. The investments are summed and multiplied in the same manner, but then all the money is given to the husband. In the third treatment (*all to female*) all the common pool is given to the wife. In the fourth (fifth) treatment only the wife (husband) gets an initial endowment of Birr 80 (the other spouse get nothing) and after contribution and multiplying by 1.5 the common pool is divided equally between the two; these two treatments are named *female* and *male endowments* respectively. Treatments 8 and 9 are variations of the trust game; in treatment eight (nine) all the endowment is given to the wife (husband) and after contribution and augmenting the common pool the money is given to the husband (wife) for allocation as he (she) desires. These are respectively called *female* and *male trust*. Treatments 10 and 11 are variations of the dictator game. In treatment 10 (*female dictator*) all the endowment (Birr 80) is given to the wife and the allocation of the common pool is also decided by the wife; similarly, all endowment to and allocation by husband constitutes the *male dictator* variant (treatment 11).

In all the treatments described above, the endowment to each spouse was private information (known only to the individual) whereas the amount in the common account and how it will be allocated was common knowledge. We told participants that,

> "The exact amount will vary between people, but you will receive something between 0 and Birr 40. ... Your wives will each receive a similar envelope and they will each receive an amount of money between 0 and Birr 40. They don't know how much you have in your envelope and you won't be told how much they have in their envelopes. None of you will know what the others have."

Table 1: Treatments of experimental games

No.	Treatment Name	Public or private	Female endowment (Birr)	Male endowment (Birr)	Allocation	No. of hhs.
1	Investment baseline	Private	40	40	50:50	120
2	All to male	Private	40	40	Male takes	40
3	All to female	Private	40	40	Female takes	40
4	Female endowment	Private	80	0	50:50	40
5	Male endowment	Private	0	80	50:50	40
6	Female control	Private	40	40	Female	120
7	Male control	Private	40	40	Male	120
8	Female trust	Private	80	0	Male	80
9	Male trust	Private	0	80	Female	80
10	Female dictator	Private	80	0	Female	40
11	Male dictator	Private	0	80	Male	40
12	Public endowments	Public	40	40	50:50	40
13	Public female trust	Public	80	0	Male	80
14	Public male trust	Public	0	80	Female	40

Note: Treatments that involve 'production' are not reported in this table.

Full information about each individual's endowment was not revealed to mimic the typical household situation. Asymmetric information about individual resources and spending is a familiar part of household behaviour in many cultures. To examine the effect of information, four treatments that reveal information on initial endowments were added. Treatment 12 (*public endowments*) is the same as investment baseline except that spouses know what the other has received. Treatments 13 and 14 (*public female and public male trust* respectively) are like the trust games of treatments 8 and 9 but with full information (look at Table 1 for a summary of the treatments).

In addition to the fourteen treatments there are five variants that include a 'production' stage; the production stage determines the endowments of spouses. These variants are implemented to examine how production affects entitlements and intra-household allocations. In this paper these treatments are not included because they are significantly different from those that don't include production.

The next section outlines the data collection process.

3. Data collection

The research project was implemented in three sites with a total of 1,200 married couples. There were one urban site (Addis Ababa, the capital city) and two rural sites: Mehal Meda and Hadiya, northeast and southwest of Addis Ababa respectively. In each site, five locations were selected. In the case of rural sites, these five locations were distinct villages. The villages had been pre-selected in the month leading up to the main fieldwork using local

informants and prior visits by members of the research team. The major selection criteria for the five locations in each site were size (needed to recruit 80 couples from each place) and separation from the other sites (to limit cross-contamination). The experiments took place during 5 consecutive days in 2009 in each research site.

The two rural sites were specifically chosen to capture important differences in the farming systems and ethnic composition in Ethiopia. The northern site is characterised by the traditional ox-plough culture and the production of cereals/annuals. It is mainly populated by the Amhara ethnic group, the second largest ethnic group in Ethiopia. The southern site depends on the hoe culture for farming and its dependence on perennial crops is pronounced. It is inhabited mainly by one of the minority ethnic groups in Ethiopia. The northern site is located in a farming system that is traditionally characterised by centralised control of agricultural decisions in the hands of the male household head. In contrast, females have stronger involvement in the management of the staple crop in the southern site.

In Addis Ababa we run experiments in five different *kebeles*[2]. The selection of the urban site is to examine whether urbanisation/modernisation significantly affects intra-household allocations. In addition, urban areas are characterised with much more mixed ethnic composition than rural areas.

In each location, prior visits were made to select participating households. List of households provided by the *kebeles* were used as sampling frame to randomly selected 90 households per location, ten of which as reserves (again randomly) to be used in case some don't show-up.

Six female and six male research assistants – from a pool of numerous applicants – were recruited to run the experiments. The institutional support and network of the local partner organisation – the Ethiopian Economic Policy Research Institute – was instrumental in the recruiting high quality manpower. Most of the research assistants have long experience with the implementation of household surveys. All of them speak good English. The research assistants received five days of training from three UK-based researchers including a pilot using a small sample of subjects. The experimental scripts were translated into the local language by an experienced translator and thoroughly checked by a member of the research group.

Across the 15 locations in the three sites, different venues were used including community centres, middle and secondary schools as well as farm buildings. The schedule for the five game days was as follows: five treatments in the morning and five treatments in the afternoon. Secrecy was ensured by splitting wives and husbands into separate rooms and then calling one person at a time to take their decisions. Each spouse received an envelope with the endowment and privately removed what he/she wanted to keep for him/herself, with the remainder left for the common account. The research

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[2] *Kebele* is the lowest administrative sub-division in Ethiopia. In rural areas, *kebele* is also known as Peasant Association.

assistants collected back the envelopes and recorded the decisions. At the end, envelopes were matched and couples were paid in private.

In the few days after the experimental games, comprehensive household surveys were conducted. Separate questionnaires for wives and husbands who participated in the experiments were completed. These questionnaires provide a rich data set about the socio-economic characteristics of the households especially focusing on intra-household issues. Detailed qualitative data on intra-household allocation and norms of conjugality were also collected from a sub-set of the spouses that participated in the experiments.

The next section presents the main experimental results.

4. Experimental results

This section summarises the main experimental results. First, the logical consistency of experimental results is examined to ascertain that confusion and misunderstanding of players are not driving the main results. Second, tests of efficiency in contribution behaviour are conducted. Third, whether the contribution behaviour of players is influenced by other concerns than efficiency is explored. Finally, the actual and expected contribution of spouses are analysed to examine if there are significant deviations between actual and expected behaviour.

The experimental games are of relatively simple design but due to the low level of education and the unfamiliar nature of the exercise for the players much care was taken to be sure that participants understood the games. The scripts of instructions translated into the local language were read before the start of the games. Control questions that test the understanding of the players were asked and the games were again explained for those that didn't fully understand the instructions. The understanding of the players can be examined by looking at some logically expected contribution patterns in different but related treatments. For example, male contribution rates are expected to be the same in treatments 2 ('all to male') and 7 ('male control') on the one hand and treatments 2 and 11 ('male dictator') on the other. Note that all the common pool is given to the husband in treatment 2 to be taken home while in treatments 7 and 11 he controls the allocation of the common pool where he has the right to take all the money as in treatment 2. The virtual equivalence in the allocation rules in the three treatments should induce the same contribution behaviour if there is no confusion. The same is true for wives for treatments 3 ('all to female') and 6 ('female control') on the one hand and treatments 3 and 10 ('female dictator') on the other. Table 2 reports both parametric (t) and non-parametric (Mann-Whitney) tests for equality of male and female contribution rates in the corresponding treatments. All the tests indicate that the null hypothesis of equality in contribution rates is accepted at standard p-values supporting that players' behaviour in the games was logically consistent.

Table 2: Consistency checks: tests for equality of contributions of husbands and wives in similar treatments

	t-test		Mann-Whitney test	
	t-stat	p-value	t-stat	p-value
Male contribution in treatments 2 & 7	1.2982	0.1961	1.292	0.1964
Female contribution in treatments 3 & 6	0.8788	0.3809	1.163	0.2447
Male contribution in treatments 2 & 11	1.0890	0.2795	0.866	0.3865
Female contribution in treatments 3 & 10	1.1135	0.2689	1.571	0.1161

Note: The t-tests are with the assumption of equal variances; but even with unequal variances the results hold.

The above results indicate consistency in the behaviour of the players which provides more confidence in the quality of the experimental data. Reassured with the quality of data, we move on to the next task of analysing efficiency using contribution rates of husbands and wives. Note that for an efficient outcome the total amount of money in the common pool should be maximised and for that spouses should contribute all their endowments. Hence, the test for efficiency is a test of whether contribution rates are equal to 1 (or 100%).

Table 3 presents the mean male and female contribution rates. It's apparent that contribution rates are much lower than 100% with an overall average of 56%; spouses on the average contribute only a little bit more than half of their endowments to the common pool. On the average, males contribute more than females, contribution rates are highest in the urban site Addis Ababa followed by the southern site Hadiya. It looks that contribution rates significantly differ across treatments ranging from a high of 70% (males in treatment 12) to a low of 40% (females in treatment 4). This significant variation between treatments is observed even if contribution rates are disaggregated by regions implying that the variation is not driven by inter-regional differences.

Statistical tests confirm that contribution rates are significantly lower than 100% as the figures in Table 4 imply. At both aggregated and disaggregated levels (by regions and treatments) the null hypotheses that contribution rates equal 100% are decisively rejected without exception. This is also true for each treatment in each region (see Table A1 in the Appendix). These results strongly show that the spouses consistently failed to realise all potential surplus. If the mean contribution rate of 56% is considered, this implies that from the total amount of money all players could have taken home they left 44% with the researchers; this is a huge amount of loss. These results cast a shadow of doubt on all intra-household models that assume efficient outcomes giving support to non-cooperative models.

Result 1: In all regions and treatments of games a large amount of potential surplus remains unrealised indicating a high level of inefficiency. This provides some experimental evidence that supports non-cooperative intra-household models.

Table 3: Mean household, male and female contribution rates

	Household		Male		Female	
	Mean	**St. error**	**Mean**	**St. error**	**Mean**	**St. error**
			Overall			
	0.560	0.008	0.594	0.010	0.538	0.010
			By region			
Amhara	0.511	0.015	0.547	0.018	0.462	0.020
Hadiya	0.548	0.013	0.599	0.016	0.531	0.016
Addis Ababa	0.629	0.014	0.643	0.019	0.608	0.017
			By treatment			
1	0.602	0.017	0.615	0.022	0.590	0.023
2	0.672	0.037	0.662	0.041	0.681	0.044
3	0.506	0.031	0.506	0.045	0.506	0.034
4	0.403	0.033			0.403	0.033
5	0.522	0.039	0.522	0.039		
6	0.512	0.016	0.556	0.021	0.469	0.022
7	0.559	0.023	0.598	0.025	0.521	0.028
8	0.553	0.030			0.553	0.030
9	0.656	0.030	0.656	0.030		
10	0.453	0.033			0.453	0.033
11	0.594	0.048	0.594	0.048		
12	0.694	0.033	0.700	0.040	0.688	0.043
13	0.552	0.035			0.552	0.035
14	0.491	0.057	0.491	0.057		

Table 4: Parametric (t-) and nonparametric (Wilcoxon signed rank) tests of efficiency for male and female contribution rates

	Male		Female	
	t-test (t-stat)	**Wilcoxon (z-stat)**	**t-test (t-stat)**	**Wilcoxon (z-stat)**
		Overall		
Overall	-39.2551	-21.985	-45.4013	-22.821
		By region		
Amhara	-24.9103	-13.173	-27.2904	-12.165
Hadiya	-24.5758	-13.215	-29.6870	-14.308
Addis	-18.8728	-11.625	-23.1839	-13.008
		By treatment		
1	-17.2703	-9.329	-17.7909	-9.330
2	-8.3172	-5.168	-7.2705	-4.828
3	-10.9257	-5.457	-14.4916	-5.589
4			-18.2345	-5.565
5	-12.2884	-5.524		
6	-21.3260	-9.567	-24.3087	-9.581
7	-15.8740	-9.120	-17.2076	-9.179
8			-14.7048	-7.605
9	-11.6032	-7.417		
10			-16.3737	-5.536
11	-8.4004	-5.323		
12	-7.4568	-4.963	-7.3193	-5.017
13			-12.9719	-7.454
14	-8.9586	-5.310		

Note: The null hypotheses of the tests are that contribution rates are 100%. All p-values are 0.0000. All tests on disaggregated levels – by treatments and regions – are significantly rejected (at p=0.0000) without exception.

Next we explore if there are systematic and significant differences between male and female contribution rates. Table 5 presents the statistical tests for equality of male and female contribution rates for those treatments

where both women and men have initial endowments of Birr 40. Differences are significant at the disaggregated level in only two treatments – treatments 6 and 7 in both cases males contributing more. These results provide weak evidence for gender differentiation in contribution behaviour. In addition, contrary to the prediction of models that argue that women are expected to contribute more to the household (for example, Sen 1990) the weak evidence suggests the opposite.

Table 5: Parametric (t-) and nonparametric (Wilcoxon signed rank) tests for equality of male and female contributions

	t-test		Wilcoxon signed rank test		Which is higher if significant?
	t-stat	p-value	z-stat	p-value	
Overall	-3.8623	0.0001	-3.115	0.0018	Male
Treatment 1	-0.8606	0.3912	-0.827	0.4080	
Treatment 2	0.4427	0.6604	0.331	0.7409	
Treatment 3	0.0000	1.0000	0.222	0.8240	
Treatment 6	-3.1411	0.0021	-3.071	0.0021	Male
Treatment 7	-2.8128	0.0057	-2.378	0.0174	Male
Treatment 12	-0.2552	0.7999	-0.162	0.8711	

Note: The null hypotheses of the tests are that contribution rates are 100%

Result 2: *The evidence for significant differences in contribution behaviours of males and females is rather weak; in addition, the existing evidence indicates that in the small number of cases where contribution rates are significantly different males contribute more than females contrary to the expectation of some models (e.g., Sen 1990).*

Differences in male and female contribution rates can be examined in a different way. The tests reported in Table 5 look at within game differences and use data from games that are played in the same regions to avoid regional confounding effects. Potential differences in male and female contribution rates between similar games that are played in the same regions can also be used to examine gender differences. Specifically, treatments 8 and 9 (female and male trust) both of which are played in two regions – Amhara and Addis Ababa – provide an opportunity to test whether there are significant differences in male and female contributions. Both parametric and non-parametric tests reported in Table 6 indicate that male contribution rates in treatment 9 (male trust game) are significantly higher than female contribution rates in treatment 8 (female trust). On the one hand, this reinforces the previous result that if there are significant differences males generally contribute more. On the other, it seems that husbands trust their wives more than wives their husbands.

Result 3: *The results from the trust games indicate that on the one hand male contribution rates are significantly higher than that of females, reinforcing Result 2 above and on the other male trust is stronger than female trust, i.e., husbands trust their wives more than wives trust their husbands.*

Table 6: Tests for equality of husband and wife contribution rates in female and male trust games

Mean female contribution in treatment 8 (female trust)	0.5531	
Mean male contribution in treatment 9 (male trust)	0.6563	
T-test	t-stat	p-value
	2.5814	0.0117
Wilcoxon rank-sum (Mann-Whitney) tests	z-stats	p-value
	-2.417	0.0156

Note: the t-tests are with the assumption of equal variances; but even with unequal variances the results hold.

As discussed in the previous section, the three survey sites were selected to examine if significant differences between urban and rural areas on the one hand and between rural households located in different farming systems on the other hand exist. To address this, statistical tests for differences in wives' and husbands' contribution rates in each region compared to the other two are conducted (see Table 7). The first panel of the table reports the tests for male and female contribution rates and the results imply that both male and female contribution rates are highest in Addis Ababa followed by Hadiya with Amhara standing third. But since all treatments of the games are not played in all the three research regions, these differences may be influenced by differences between treatments rather than regions. To control for this the second part of the table reports similar types of tests for treatments that were played in all the three research sites. Now, male contribution rates are no more significantly different between the regions. In the case of females, in the two treatments except for treatment 1 the differences are significant at least at 10% level with contribution rates being highest in Addis Ababa and lowest in Amhara. These results imply that regional differences are small and the existing differences mainly are explained by variations in female contribution rates.

Result 4: Generally regional differences in contribution rates are rather low; existing regional variations mainly are explained by differences in female rather than male contribution rates.

As presented in the previous section in most of the treatments initial endowments were private; spouses don't know how much the other has received. But particularly in treatments 13 and 14 initial endowments are made public; spouses know what the other has received. These variations provide a good opportunity to test how information asymmetries affect behaviour. Generally, one would expect that public information would encourage cooperation and increase contribution to the common pool as it increases the cost of hiding from a spouse.

Table 7: Contribution rates of husbands and wives by regions

	Mean contribution rates		Tests			
	Male	Female	Male		Female	
			Overall			
			T-tests			
			t-stat	p-value	t-stat	p-value
Amhara	0.547	0.462	3.3303	0.0009	4.6830	0.0000
Hadiya	0.599	0.531	-0.3702	0.7114	0.5030	0.6152
Addis Ababa	0.643	0.608	-3.0981	0.0020	-4.9873	0.0000
			Mann-Whitney tests			
			z-stat	p-value	z-stat	p-value
Amhara			3.358	0.0008	5.131	0.0000
Hadiya			-0.490	0.6243	0.371	0.7106
Addis Ababa			-3.009	0.0026	-5.259	0.0000
			Treatment 1			
			T-tests			
			t-stat	p-value	t-stat	p-value
Amhara	0.5875	0.5375	0.8572	0.3931	1.6070	0.1107
Hadiya	0.6625	0.6438	-1.5267	0.1295	-1.6728	0.0970
Addis Ababa	0.5938	0.5875	0.6585	0.5115	0.0636	0.9494
			Mann-Whitney tests			
			z-stat	p-value	z-stat	p-value
Amhara			0.793	0.4276	1.445	0.1485
Hadiya			-1.314	0.1888	-1.585	0.1130
Addis Ababa			0.521	0.6024	0.140	0.8886
			Treatment 6			
			T-tests			
			t-stat	p-value	t-stat	p-value
Amhara	0.5750	0.3438	-0.6356	0.5263	4.3364	0.0000
Hadiya	0.5375	0.4938	0.6356	0.5263	-0.8077	0.4209
Addis Ababa	0.5563	0.5688	0.0000	1.0000	-3.3737	0.0010
			Mann-Whitney tests			
			z-stat	p-value	z-stat	p-value
Amhara			-0.337	0.7359	4.506	0.0000
Hadiya			0.141	0.8879	-0.561	0.5750
Addis Ababa			0.196	0.8445	-3.945	0.0001
			Treatment 7			
			T-tests			
			t-stat	p-value	t-stat	p-value
Amhara	0.5313	0.4313	1.8808	0.0625	2.3162	0.0223
Hadiya	0.6313	0.5375	-0.9300	0.3543	-0.4218	0.6740
Addis Ababa	0.6313	0.5938	-0.9300	0.3543	-1.8709	0.0638
			Mann-Whitney tests			
			z-stat	p-value	z-stat	p-value
Amhara			1.724	0.0846	2.552	0.0107
Hadiya			-1.025	0.3052	-0.756	0.4499
Addis Ababa			-0.699	0.4845	-1.796	0.0725

Note: The null hypotheses for the tests are that contribution rates in the region are the same as the other two.

Table 8 provides tests for male and female contribution rates in similar treatments but where information on initial endowment is either private or public; the tests use only data from games that are played in the same site/s to control for potential confounding regional effects. The comparisons of male and female contribution rates in treatments 1 and 12 provide rather weak evidence (significant at 10% level) that information, as expected, increases

contribution rates. But contribution rates are not sensitive to public information in the trust games (treatments 9 and 14 for husbands and treatments 8 and 13 for wives). These results imply that the effect of information is mediated by the specific context in which more information is revealed. Public information automatically doesn't guarantee increases in efficiency let alone full efficiency – note that even in those treatments where endowments are public information contribution rates are far below 100%.

Table 8: The role of information

Treatment	**Male contribution**				
	Mean contribution	t-test		Mann-Whitney test	
		t-stat	p-value	z-stat	p-value
		For Addis Ababa only			
1 (investment baseline)	0.5938	-1.9543	0.0542	-1.7560	0.0791
12 (public endowments)	0.7000				
		For Amhara only			
9 (male trust)	0.5781	1.2387	0.2192	1.4190	0.1560
14 (public male trust)	0.4906				
	Female contribution				
	For Addis Ababa only				
1 (investment baseline)	0.5875	-1.7598	0.0824	-1.759	0.0787
12 (public endowments)	0.6875				
	For Amhara and Addis Ababa only				
8 (female trust)	0.5531	0.0339	0.9730	0.2300	0.8179
13 (public female trust)	0.5516				

Result 5: *Both male and female contribution rates increase as expected (but weakly) with public information of initial endowments in the investment baseline. But contribution rates of both are not sensitive to public information in the trust games. These results imply that the effect of public information is contextual depending on the levels of endowments and allocation rules.*

The above result implies that asymmetric information likely plays an important role in intra-household allocations but its effect is modified by institutional arrangements. Related to the issue of asymmetric information, for equilibrium in a classic game theoretic framework the mutual expectations of spouses should be accurate reflections of actual behaviour. "In equilibrium players are never surprised by what other players do" (Camerer, 2010). Whether the spouses had accurate expectations of each other's behaviour in the experimental games is an important indication of equilibrium behaviour and this can be tested in the following way.

Spouses were asked what amount of money they expect that the other spouse will keep for herself/himself from the initial endowment. These expected amounts are compared with the actual amounts kept by spouses (look at Table 9). In all cases equality is strongly rejected. In addition it's interesting to note that the errors in the expectations of husbands and wives are systematic and opposite. While wives' expectations of the amounts husbands will keep are significantly higher than what husbands actually keep, husbands' expectation of the amount wives will keep is significantly lower than what wives actual keep. In other words, wives' expectations of the amounts their husbands will contribute to the common pool are significantly lower than what husbands actually contribute. Husbands are more

cooperative than their wives' expect. On the other hand, wives are less cooperative than their husbands' expect.

Table 9: Actual and expected contribution behaviour

Actual amount kept by husband	19.387	
Expected amount by wife	21.687	
	t-stats	p-value
t-test	-3.6207	0.0003
	z-stats	p-value
Wilcoxon signed rank-test	-4.420	0.0000
Actual amount kept by wife	22.944	
Expected amount by husband	20.570	
	t-stats	p-value
t-test	3.4264	0.0006
	z-stats	p-value
Wilcoxon signed rank-test	3.117	0.0018

Note: Actual amount kept by spouse is the mean amount of initial endowment kept by the spouse. Expected amount by a spouse is the expectation about this amount from the other spouse.

Table 10: Actual contribution by husbands and wives' expectation by treatment

		t-test		Wilcoxon signed rank-test	
		t-stats	p-value	z-value	p-value
Treatment 1					
Actual amount kept by husband	15.42	-5.3218	0.0000	-4.712	0.0000
Expected amount by wife	21.50				
Treatment 2					
Actual amount kept by husband	13.50	-1.3500	0.1848	-1.542	0.1230
Expected amount by wife	16.00				
Treatment 3					
Actual amount kept by husband	19.75	-2.3948	0.0215	-2.395	0.0166
Expected amount by wife	24.75				
Treatment 6					
Actual amount kept by husband	17.75	-3.2586	0.0015	-2.944	0.0032
Expected amount by wife	21.17				
Treatment 7					
Actual amount kept by husband	16.05	-4.3772	0.0000	-3.430	0.0006
Expected amount by wife	22.61				
Treatment 9					
Actual amount kept by husband	27.34	4.1003	0.0001	3.539	0.0004
Expected amount by wife	17.62				
Treatment 11					
Actual amount kept by husband	32.5	2.8551	0.0069	2.538	0.0111
Expected amount by wife	21.00				
Treatment 12					
Actual amount kept by husband	12.00	-2.9403	0.0055	-2.613	0.0090
Expected amount by wife	19.50				
Treatment 14					
Actual amount kept by husband	40.75	-0.6666	0.5089	-0.400	0.6892
Expected amount by wife	44.00				

Note: Actual amount kept by spouse is the mean amount of initial endowment kept by the spouse. Expected amount by a spouse is the expectation about this amount from the other spouse.

The figures reported in Table 9 are aggregate figures for all games. In Table 10 and Table 11 the actual and expected contributions of husbands and wives for each treatment are respectively reported. Except two cases for

husbands' and four for wives' all the rest are significantly different at least at 10% level, i.e., the actual behaviour of the players are significantly different from what their spouses expect. In addition, more or less the errors in expectations repeat the patterns observed at the aggregate level. With respect to husbands' contribution and their wives expectations, in eight out of the ten significant cases expected amounts are higher than actual amounts; husband contribute more to the common pool than their wives expect. The results for wives' contribution are more mixed. Out of the eight significant cases in four wives contribute less than what their husbands expect. So, while the case of husbands overestimating the contribution of their wives' holds in the majority of cases, the case of wives underestimating their husbands' contribution holds in around half of the cases.

Table 11: Actual contribution by wives and husband's expectation by treatment

		t-test		Wilcoxon signed rank-test	
		t-stats	p-value	z-value	p-value
Treatment 1					
Actual amount kept by wife	16.42	-2.0855	0.0392	-1.880	0.0601
Expected amount by husband	19.08				
Treatment 2					
Actual amount kept by wife	12.75	-2.7964	0.0080	-2.243	0.0249
Expected amount by husband	21.00				
Treatment 3					
Actual amount kept by wife	19.75	-0.3931	0.6964	-0.760	0.4475
Expected amount by husband	20.50				
Treatment 4					
Actual amount kept by wife	47.75	9.4692	0.0000	5.196	0.0000
Expected amount by husband	19.75				
Treatment 6					
Actual amount kept by wife	21.17	1.4736	0.1432	1.742	0.0815
Expected amount by husband	19.5				
Treatment 7					
Actual amount kept by wife	19.17	1.2530	0.2127	1.534	0.1250
Expected amount by husband	17.5				
Treatment 8					
Actual amount kept by wife	35.75	4.0132	0.0001	3.886	0.0001
Expected amount by husband	23.63				
Treatment 10					
Actual amount kept by wife	43.75	8.5416	0.0000	5.179	0.0000
Expected amount by husband	18.00				
Treatment 12					
Actual amount kept by wife	12.5	-2.0233	0.0499	-1.885	0.0595
Expected amount by husband	17.25				
Treatment 13					
Actual amount kept by wife	35.88	-0.0770	0.9388	0.323	
Expected amount by husband	36.13				0.7465

Note: Actual amount kept by spouse is the mean amount of initial endowment kept by the spouse. Expected amount by a spouse is the expectation about this amount from the other spouse.

These systematic differences in expectations and actual behaviour imply that the attainment of the equilibrium in this set-up is unlikely. In repeated games players may attain more convergence between expected and actual behaviour leading towards an equilibrium path. But note that the players in our experimental games are real married couples that have lived

together, some for a very long period to time. Hence, this more or less systematic error in expectations persists even after this repeated interaction between the spouses in the real world.

Result 6: The actual and expected contribution behaviour of spouses are significantly different from each other. Generally females contribute less than what their husbands expect and males contribute more than what their wives expect. These systematic errors in actual and expected behaviour cast doubt on whether the expectations of spouses are aligned to attain equilibrium as in the classical game theoretic framework.

At the beginning of this section tests on whether contribution rates equal 100% were decisively rejected at both aggregate and disaggregated levels indicating low levels of efficiency in terms of realising potential surplus from the games. In addition to the fact that spouses contribute much less than 100%, the distribution of contribution rates reveal an interesting pattern. Figure 1 and Figure 2 present the histograms of male and female contribution rates for each treatment. In all cases, it is apparent that the mass of the distributions is concentrated around the middle. This gives the impression that players may be following another rule than maximising surplus such as simple rule of thumb or a fairness norm. To formally examine whether contribution rates converge to specific values other than 1 (100%) a series of tests were conducted. Note that contributions are made from the set of (0, 10, 20, 30, 40) for endowment of Birr 40 and from the set of (0, 10, 20, 30, 40, 50, 60, 70, 80) for endowment of Birr 80 implying that the set of all possible contribution rates are (0, 0.125, 0.25, 0.375, 0.5, 0.625, 0.75, 0.875 and 1). Whether contribution rates equal to each of these contribution rates was tested. Invariably these were almost always rejected for other contribution rates than 0.5; the tests for contribution rates being equal to 0.5 for each treatment are given in Table 12.

Figure 1: Histograms of male contribution rates by treatment

Graphs by treatment

Figure 2: Histograms of female contribution rates by treatment

Graphs by treatment

Table 12: T-tests for contribution rates being equal to 0.5

Treatment	Male		Female	
	t-stat	p-value	t-stat	p-value
1	5.1344	0.0000	3.8833	0.0002
2	4.0046	0.0003	4.1342	0.0002
3	0.1383	0.8907	0.1834	0.8554
4			-2.9595	0.0052
5	0.5706	0.5715		
6	2.7033	0.0079	-1.4299	0.1554
7	3.8657	0.0002	0.7482	0.4558
8			1.7481	0.0843
9	5.2742	0.0000		
10			-1.4035	0.1684
11	1.9386	0.0598		
12	4.9712	0.0000	4.3916	0.0001
13			1.4915	0.1398
14	-0.1649	0.8699		

The null hypotheses that contribution rates are equal to 0.5 are accepted for the ten (at 5%) out of the twenty tests. This gives the impression that players at least for some of the treatments were probably following a simple rule that reflects a fairness or similar norm ("a spouse should contribute half of his/her money to the household"). It seems a contribution rule that divides endowments into equal halves to the individual and to the household has a much better predictive power than efficiency considerations.

Result 7: Half of the contribution rates of spouses are not statistically different from 50% implying that a non-negligible proportion of the players probably were using simpler rules of thumb that may reflect underlying norms like fairness norms rather than maximising total surplus.

So far, the main experimental results were analysed and presented. As indicated in the previous section, in addition to the experimental games, the research project also collected data using household surveys. In the next

section, the correlation between contribution behaviour in the games and socio-economic characteristics of households are examined.

5. Household efficiency and socio-economic characteristics of households

In addition to the experimental games, detailed information on the socio-economic characteristics of households was collected through a household survey which was conducted after the experimental games to avoid possible contamination. In addition to basic characteristics like age, educational level and main occupation, very detailed information on decision-making within the household, previous marriage experiences, background information on parents of spouses, wealth, consumption expenditures and many other aspects relevant to intra-household relationships were gathered. The mean of the main variables used in analyses in this section are given in Table 13.

Even though the average age of participants is around 40 years, it ranges between a low of 16 to a high of 95 years. As in many countries, females marry younger, probably much younger, in Ethiopia and hence while the average age of wives is 35 that of husbands is 43. This age difference presumably can be important in intra-household relationship in a society like Ethiopia where respect to elders is one of the characteristic features of the culture. Around two-thirds of the players are followers of the historically dominant religion, the Ethiopian Orthodox Christian church. Compared to the total population of the country, the sample over-represents the Orthodox and Protestant churches while significantly under-representing Islam. As expected, the most important main activity is farming as two-thirds of our sample comes from rural areas. This is followed by childcare and household chores. As expected, there is a strong gender division of labour; only around 20% of females reported farming as their main activity while 67% reported childcare and household chores. The corresponding figures for males are 66% and only 4%. The information on main activities also shows the limited opportunities for non-farm activities in rural areas. For example, only less than 4% of the participants from rural areas reported casual labour, employee, self-employed and other main activities.

The educational level of the players is very low; for example, as high as 73% of the players have six or less than six years of education. There are two significant contrasts in levels of education attained. First, the rural-urban difference: for example, the proportions of players with six or less years of education are 83% and 50% for the rural and urban sites respectively. Second, the female-male difference: the corresponding figures for males and females are 80% and 59%. Urban areas compared to rural and males compared to females are much more educated.

To examine whether parental background is important, the main activities of the fathers and mothers of the players are given. A very similar pattern of distribution in main activities as the spouses themselves emerges. This highlights the lack of structural transformation in the Ethiopian economy when comparing the occupations of two generations. In an economy with

rapid growth and structural transformation significant differences in occupations of parents and children are expected.

Table 13: Descriptive statistics

Variables	Mean	Variables	Mean
Contribution rate	0.565	**Time to father's house**	
Male	0.500	Father lives in the house	0.175
Age	39.535	Less than a day	0.746
Religions		More than a day	0.079
Islam	0.052	**Parents alive?**	
Orthodox	0.630	Father alive	0.678
Protestant	0.314	Mother alive	0.521
Catholic	0.003	**Type of marriage**	
Main activities		Ceremonial	0.517
Working on farm	0.449	Elopement	0.119
Casual labour	0.056	Levirate	0.031
Employee	0.091	Living together	0.332
Self-employed	0.038		
Childcare/household chores	0.334		
Other	0.031	Marriage registered?	0.488
Educational levels		**How spend most of the day**	
Illiterate	0.389	Work on farm	0.413
Only literate	0.071	Work on own business	0.098
1-6 yrs of education	0.274	Agricultural paid work	0.008
7-12 yrs of education	0.249	Non-agricultural paid work	0.127
More than 12 yrs	0.017	Unpaid work	0.354
Mothers' main activity		**Who has most leisure time?**	
Working on farm	0.372	Husband	0.360
Casual labour	0.006	Wife	0.330
Employee	0.026	The same	0.310
Self-employed	0.008	**Wife should tolerate beating**	
Childcare/household chores	0.576	Strongly agree	0.217
Other	0.012	Agree	0.371
Fathers' main activity		Disagree	0.238
Working on farm	0.839	Strongly disagree	0.174
Casual labour	0.015	**Remarriage index**	
Employee	0.102	Male; age<25	3.149
Self-employed	0.024	Male; 35>age>=25	3.091
Childcare/household chores	0.005	Male; 50>age>=35	3.101
Other	0.016	Male; age>50	1.673
Time to mother's house		Female; age<25	2.318
Mother lives in the house	0.177	Female; 35>age>=25	2.281
Less than a day	0.748	Female; 50>age>=35	2.255
More than a day	0.075	Female; age>50	0.367

Around three quarters of spouses live less than one day away from their parents. But there is an interesting gender and rural-urban contrast. While around 27% of the fathers and mothers of the husbands live inside the same house as they do, this figure falls to 7% for wives. This reflects the patrilocal nature of most marriages in Ethiopia: women go to the locality of their husbands' family. But this difference almost completely disappears in Addis Ababa, the urban site; while the proportion of wives living with their parents is 8%, the figure for husbands is only 11%. The corresponding figures only for the rural sites are 6% and 35%. Hence, parents of husbands live in the house mainly in rural areas.

Less than a third and half of the parents of the spouses are alive. Interestingly, more mothers than fathers are alive in general for both husbands and wives (t = -14.2441; p = 0.0000); this mainly seems to reflect that females marry younger than men and may be is also related to higher life expectancy of women as in many countries. In addition, wives have more mothers as well as fathers alive compared to that of husbands (t = 6.1619 and 7.5004 respectively; p = 0.0000 for both). If surviving parents reinforce the position of their child in marriage and intra-household allocations, wives would have an advantage as more of their parents are still alive.

Around half of the marriages are ceremonial and registered. It's interesting that the second most frequent type of marriage is living together. Living together is mainly an urban phenomenon. From the urban sample while 48% are living together, the figure drops to 26% for rural sites.

In terms of allocation of time, as expected, most of spouses' time is used either on the farm or in the form of unpaid work like household chores and childcare. While 70% of females reported they spend most of the day doing unpaid work, 65% of males are working on farm – again a reflection of the gender division of labour. The urban-rural contrast is stark; for example, while 58% and only 2% of spouses work on farm and do paid work most the day in rural sites, the respective figures for the urban site changes to less than 1% and 39%.

Domestic violence and how much people are acclimatised to it can illuminate on intra-household relationships. Respondents were asked to respond to the statement "Wives should tolerate beating to keep family together" by choosing from four alternative answers: strongly agree, agree, disagree and strongly disagree. Around 58% of the respondents either strongly agreed or agreed with the statement. The figure for rural areas alone increases to 64% while that for Addis Ababa is 47% - still a high percentage. More interestingly, disaggregated responses by sex show that a staggering 77% of the females but only 39% of the males either strongly agree or agree with the statement. The proportion of wives believing that women should tolerate beating is an indication of how far females have been acclimatised to domestic violence.

The final part of Table 13 reports a remarriage index at different age brackets. The remarriage index is calculated in the following way. In the household survey all respondents were asked how long it takes for divorced males or females in a certain age group to remarry in the community. Four age groups were used: 25 years or younger, between 25 and 35 years, between 35 and 50 years and older than 50 years. The time to remarry is classified into five: one year or less, between 1 and 2 years, between 2 and 5 years, more than five years and never remarry. Each category of time was given a weight ranging from zero to four, zero being for "they never remarry" and 4 for "remarry in one year or less". These responses are averaged for the age groups at the region level – i.e., for a specific age-sex group there is only one remarriage index in a region. These age-sex specific regional level remarriage indices are then attached to each spouse depending on their sex and age. Two interesting patterns emerge. The remarriage indices more or less seem to

consistently fall with age for both males and females – older people have less chance of remarrying. To examine if the age-sex classification may have covered some nonlinear effects, fractional polynomial regression of the remarriage index on age was done. Figure 3 presents the fractional polynomial plot. As can be seen from the graph, remarriage index initially rises and then consistently falls with age. Hence, even though the chance to remarry improves at the initial few years, it decreases with age for most of the age range. Second, for all age groups the remarriage indices of males are higher than that of the females. If remarriage potential influences intra-household allocations as an outside option as argued in most economics intra-household models, males will have the advantage.

Figure 3: Age and remarriage index
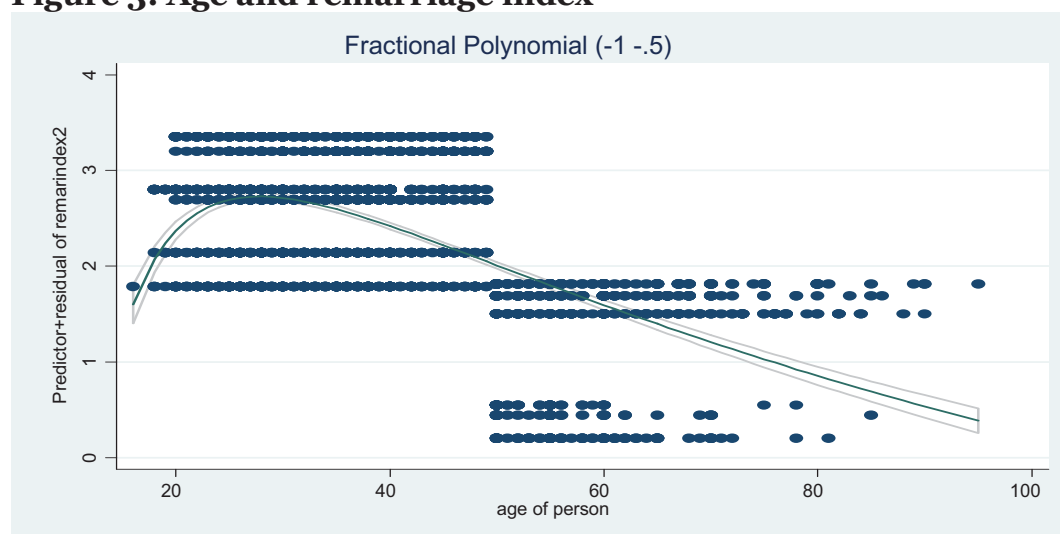
The above descriptive statistics provide a fairly good idea of the socio-economic characteristics of spouses in our sample. But the main objective here is to examine if these socio-economic characteristics are systematically correlated to contribution behaviour in the games using a multivariate framework. Are levels of efficiency in the experimental games significantly correlated to individual, household and community level characteristics? This helps on the one hand to understand whether the experimental results have external validity. The importance of combining these two types of data as a validation exercise should not be underestimated as they are collected through different data generating processes.

An econometric problem that should be carefully handled when doing this analysis is the problem of endogeneity. Contribution rates are regressed on socio-economic variables to identify correlates of household efficiency. In doing so, household level unobservables that affect contribution rates are expected to be correlated to the variables included in the regressions. To control for that, household fixed effects estimates are mainly used – as long as the endogeneity stems from household level time invariant factors this will be a solution. Household level fixed effects regressions are made possible because for each household two spouses are observed. For this purpose, the data are organised on the level of spouses; hence, with the 1,200 sample households and with each household having two spouses, the maximum number of observations becomes 2,400. The results from four versions of

household fixed effects regressions are reported in Table 14 subsequent columns control for more variables to examine if results are robust to the inclusion and exclusion of variables. In all the four cases, the Hausman specification test supports the household fixed effects models. For comparative purposes, the household random effects regression results are given in Table A2 in the Appendix.[3]

In general, sex doesn't seem to be an important determinant of contribution rates. Even though in previous comparisons, at least in some treatments, males contributed more than females, in a regression framework the coefficient on the male dummy becomes negative and significant (at 10%) in one case. Age is more important than sex with contribution rates increasing with it but with a possibly small diminishing effect (at least in two cases, age squared is negative and significant at 10% level but with a small magnitude). It's interesting to note that age is not significant in the random effects estimates given in the Appendix implying correlation between age and unobserved household fixed effects is likely important.

Result 8: When controlling for other variables, while the correlation of sex to contribution rates is almost non-existent, there is a stronger positive correlation with age with some very weak diminishing effects.

Interestingly, the coefficients on Protestants are significant (at least at 10%) and negative implying contribution rates are lower by this religious denomination *if the religions of the spouses differ*; note with household fixed effects regressions, the effect of same-religion spouses become household fixed effect. The coefficients indicate that, controlling for other variables, the contribution rates of Protestants are lower by between 12% and 18% compared to other religions if the spouses have different religions; this is a relatively high magnitude.[4] This may stem from the emphasis the Protestant religion places on individualism compared to the other religions.

Result 9: The contribution rates of Protestants are lower compared to followers of all the other religions when controlling for household fixed effects including same religions between spouses. The central role individualism plays in the Protestant doctrine may be the reason for this.

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[3] In addition, tobit random effects models were estimated to examine if censoring significantly affects results; since the level of censoring rather low, the tobit random effects estimates are virtually the same as the household random effects estimates.
[4] Note the coefficients in the household random effects are not significant.

Table 14: Household fixed effects regressions of contribution rates

VARIABLES	(1) Coefficient	SE	(2) Coefficient	SE	(3) Coefficient	SE	(4) Coefficient	SE
Male	-0.004	0.030	-0.016	0.033	-0.084*	0.044	-0.076	0.055
Age	0.010	0.007	0.012*	0.007	0.016**	0.007	0.015**	0.008
Age2	-0.000	0.000	-0.000	0.000	-0.000*	0.000	-0.000*	0.000
Religion (Islam omitted)								
Orthodox	0.037	0.088	0.063	0.100	0.073	0.103	0.069	0.104
Protestant	-0.124*	0.070	-0.123*	0.073	-0.176**	0.077	-0.176**	0.077
Catholic	-0.082	0.194	-0.074	0.205	0.306	0.332	0.302	0.334
Main activities (working on farm omitted)								
Casual labour	-0.157***	0.059	-0.147**	0.064	-0.118	0.087	-0.133	0.089
Employee	-0.092*	0.048	-0.111**	0.054	-0.055	0.083	-0.078	0.086
Self-employed	-0.049	0.061	-0.060	0.067	-0.018	0.084	-0.039	0.086
Childcare/household chores	-0.075**	0.034	-0.110**	0.044	-0.073	0.053	-0.078	0.054
Other	-0.139**	0.065	-0.149**	0.070	-0.106	0.085	-0.129	0.088
Educational level (not literate omitted)								
Only literate	-0.106**	0.051	-0.113**	0.052	-0.105*	0.055	-0.117**	0.056
1-6 yrs of education	0.019	0.038	0.018	0.040	0.014	0.043	0.009	0.043
7-12 yrs of education	-0.000	0.048	-0.010	0.051	-0.011	0.055	-0.018	0.055
More than 12 yrs	0.017	0.092	0.006	0.099	0.055	0.115	0.043	0.124
Mothers' main activity (working on farm omitted)								
Casual labour			0.075	0.140	0.065	0.146	0.048	0.147
Employee			0.028	0.081	0.012	0.087	0.005	0.088
Self-employed			-0.032	0.126	-0.124	0.142	-0.136	0.144
Childcare/household chores			-0.035	0.029	-0.014	0.034	-0.027	0.034
Other			0.059	0.138	0.057	0.172	0.033	0.174
Fathers' main activity (working on farm omitted)								
Casual labour			-0.061	0.095	-0.056	0.104	-0.076	0.105
Employee			0.101*	0.053	0.136**	0.056	0.115**	0.058
Self-employed			0.035	0.073	0.040	0.080	0.029	0.081
Childcare/household chores			0.000	0.000	0.000	0.000	0.000	0.000
Other			-0.010	0.091	0.033	0.092	0.038	0.093
Time to mother's house (mother lives in the house is omitted)								
Less than a day			-0.118	0.072	-0.095	0.080	-0.099	0.082
More than a day			-0.053	0.109	-0.058	0.111	-0.071	0.113
Time to father's house (mother lives in the house is omitted)								
Less than a day			0.110	0.072	0.103	0.078	0.101	0.082
More than a day			0.078	0.110	0.021	0.113	0.032	0.115
Parents alive?								
Father alive			0.024	0.026	0.012	0.027	0.018	0.028
Mother alive			0.027	0.026	0.033	0.028	0.035	0.028
How spend most of the day (work on farm omitted)								
Work on own business					-0.059	0.062	-0.058	0.064
Agricultural paid work					-0.117	0.152	-0.100	0.154
Non-agricultural paid work					-0.070	0.068	-0.060	0.069
Unpaid work					-0.138***	0.046	-0.135***	0.049
Who has most leisure time? (husband omitted)								
Wife					0.016	0.029	0.009	0.030
The same					0.032	0.031	0.036	0.031
Wife should tolerate beating (strongly agree omitted)								
Agree							0.050	0.033
Disagree							0.090**	0.041
Strongly disagree							0.059	0.039
Re-marriage index							-0.032	0.030
Constant	0.364**	0.176	0.302	0.196	0.272	0.206	0.364	0.231
Observations	1320		1301		1237		1230	
R-squared	0.077		0.113		0.156		0.170	
Number of households	882		873		853		851	

*** p<0.01, ** p<0.05, * p<0.1

Even though in all the random effects regressions all the variables on main activities of the spouses are not significant, in the first and second

models of household fixed effects a large proportion of them are significant.[5] Interestingly all significant coefficients are negative. Since the omitted main activity is 'working on farm' spouses that mainly engage in non-farm activities contributed either equal or less than those whose main activity is farming. Compared to other occupations, farming requires more cooperation between the spouses. First, depending on traditional division of labour spouses engage in relatively clearly defined but very complementary tasks in agriculture. For example, while men are responsible for ploughing and sowing, women play a more important role in some agricultural activities like weeding and caring for *enset*[6] (in the southern regions). Second, the other occupations usually don't require spouses to work together; they involve either employment outside home (casual labour, employee and self-employment) or work only by women (childcare and household chores). Both sets of factors explain why one should expect higher levels of cooperation among those involved in agricultural activities which could be the underlying reason for higher contribution rates in the experimental games.

Result 10: Those who are mainly engaged in farming activities contribute more than those in other occupations. This may be explained by the fact that farming requires a higher level of cooperation between spouses compared to other occupations mainly because spouses work together in farming.

What about the effect of education? Education may improve the skill of individuals to identify and exploit a surplus generating opportunity. In addition, the attitude of individuals towards cooperation can be influenced by education. If this is true, contribution rates are expected to increase with educational levels. The random effects regression results seem to strongly support this. First, those that have at least one year of education significantly contribute more compared to illiterate people (at 1% level). Second, the coefficients on higher levels of education are consistently higher than lower level of education. For example, in model 1, those with 1-6 years of education contribute 7.8% higher than illiterate or just literate people; those with 7-12 and more than 12 years of education respectively contribute 12.7% and 24.4% (all highly significant at 1% level). All these results collapse when controlling for household level fixed effects; in fact, those who are just literate seem to contribute *less*. This indicates that even though education probably plays a positive role in increasing the contribution rates of players, education itself is correlated to unobservable household fixed effects that increase contribution rates. Hence, the conclusion is that even though educational levels are likely positively correlated to contribution rates this is likely, at least partly, driven by unobservable household characteristics that are correlated to education rather than by education itself.

Result 11: Even though those who are more educated contribute more, this is likely driven, at least partly, by other unobservable household fixed effects correlated to levels of education.

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[5] The most likely reason why the occupation variables are no more significant in models 3 and 4 is the colinearity with the variables under "how spend most of the day".

[6] *Enset* is the 'false banana' (*enset ventricosum*) tree which is used as a staple food in many areas of southern Ethiopia.

Almost all the other variables included in the regressions are not statistically significant. To examine whether some of the variables have gender specific effects, they were interacted with the male dummy in further estimations. In addition to gender, age is also an important factor and hence similar interactive terms with age were also included in the regressions. To control for parental characteristics the main activities of parents, whether they are alive and how far the residences of parents are from where the spouses live are included. In both the random and fixed effects models, the main activities of both parents are not significantly correlated to contribution rates. Only for fathers and employee, do coefficients become significant for the fixed effects estimates. Interactive terms with gender and age were not significant. Whether parents are alive or dead was entered to see if potential support from parents is important; both dummy variables are not significant. Contribution rates are not also correlated to distance to mothers' and fathers'. Partially reinforcing the result that farming probably encourages cooperation and higher contribution rates, there is some indication that people who devote most of their time to non-agricultural activities – particularly those that are involved in unpaid work –contribute less. Here also all gender and age interactive terms are not significant. Leisure time is not generally significant.

Attitude towards wife beating is significant in one case; spouses that 'disagree' with the statement that wives should tolerate beating contribute more (significant at 5%). This gives the plausible impression that spouses who don't tolerate wife beating are more cooperative; but this interpretation is undermined by the non-significant of the coefficient on 'strongly disagree'. Interestingly, when the wife beating variable is interacted with the gender dummy the coefficient for both 'disagree' and 'strongly disagree' become significant at least at 10% and the interactive term between 'disagree' and the gender dummy (representing males) becomes significant at 10% *but* negative. This implies that mainly the effect is coming from wives – wives who 'disagree' or 'strongly disagree' with wife beating contribute more than those who 'strongly agree'. Attitude of women towards domestic violence seems to capture some underlying characteristics that influence the behaviour of wives in household investment.

Result 12: Women who are against wife beating contribute more compared to women who tolerate it. This probably is capturing some underlying characteristics of women that affect intra-household efficiency.

The remarriage index is not significant as is nor when interacted with the gender dummy. But interestingly, when interacted with age not only the positive interactive term but also the main term becomes significant (both at 5%) and negative. First, the negative main effect indicates that spouses who have a higher remarriage potential contribute less – this implies that individuals with a better outside option are less cooperative inside marriage. Second, the positive interactive term indicates that with the same remarriage potential older individuals contribute more – age seems to have an attenuating effect on the negative effect of higher remarriage index.

Result 13: Those individuals with better remarriage potential as captured by the index calculated here contribute less to the common pool

implying that spouses with better outside option are less cooperative within marriage.

This section presents some interesting correlations between contribution behaviour inside the games and socio-economic characteristics of households. The next section provides the conclusions.

6. Conclusion

The main objective of this paper is to address the issue of intra-household efficiency particularly using different versions of the voluntary contribution mechanism. The experimental and econometric analyses provide many interesting results that have far-reaching implications for intra-household models. Efficiency in contribution behaviour is decisively rejected in all treatments casting doubt on 'unitary' and 'collective' household models that assume Pareto optimality – significant amounts of potential surplus are not realised. Contribution rates by males and females are not significantly different from each other undermining models that argue females tend to contribute more to the family (for example, Sen 1990). Information on initial endowments of spouses improves contribution rates (efficiency) in some treatments while not having effect in others suggesting that the effect of information is context dependent. Actual and expected contribution rates of spouses are systematically different; husbands' expectations of their wives' contributions is higher than actual contributions and wives' expectations of their husbands' contributions are lower than actual contribution. These systematic errors in expectations imply that the attainment of equilibrium in a game theoretic framework is unlikely. Statistical tests indicate that instead of efficiency considerations other norms are likely important. For example, in many of the treatments spouses contributed around half of their endowments implying either a norm like fairness or focal points influence decisions. Overall, most of the empirical results cast doubt on cooperative models and provide some support for behaviour guided either by fairness or other norms.

The results from this paper call for more focus on non-cooperative household models and intra-household allocations determined by fairness or similar social norms. If the latter have a better explanatory power than intra-household models based on a bargaining framework, this will entail a significant shift from the current focus of the literature on bargaining models.

References

Antonides, G. and M. Kroft (2005). "Fairness judgments in household decision making." Journal of Economic Psychology **26**: 902-913.

Apps, P. and R. Rees (2007). Cooperative Household Models. Bonn, Germany, IZA.

Ashraf, N. (2009). "Spousal Control and Intra-Household Decision Making:An Experimental Study in the Philippines." American Economic Review **99**(4): 1245–1277.

Becker, G. S. (1965). "A Theory of the Allocation of Time." The Economic Journal **75**(299): 493-517.

Becker, G. S. (1973). "A Theory of Marriage: Part I." <u>Journal of Political Economy</u> **81**: 813-846.

Becker, G. S. (1974). "A Theory of Marriage: Part II." <u>Journal of Political Economy</u> **82**: S11-S26.

Becker, G. S. (1974). "A theory of social interactions." <u>Journal of Political Economy</u> **82**: 1063-1094.

Becker, G. S. (1991). <u>A Treatise on the Family</u>. Cambridge, Massachusetts and London, England, Harvard University Press.

Blundell, R., P.-A. Chiappori, et al. (2007). "Collective Labour Supply: Heterogeneity and Non-Participation." <u>Review of Economic Studies</u> **74**(2): 417-445.

Browning, M., P.-A. Chiappori, et al. (2009). "Distributional effects in household models: Separate spheres and income pooling." <u>The Economic Journal</u> **120**(June): 786-799.

Camerer, C. F. (2010). Behavioural game theory. In Duraluf, S. N. & Blume, L. E. (Eds.) *Behavioural and experimental economics*. Houndmills, Basingstoke, Palgrave Macmillan.

Chiappori, P.-A., M. Iyigun, et al. (2009). "Investment in Schooling and the Marriage Market." <u>American Economic Review</u> **99**(5): 1689-1713.

Chiappori, P. (1988). "Rational Household Labor Supply." <u>Econometrica</u> **56**(1): 63-89.

Chiappori, P. (1992). "Collective Labor Supply and Welfare." <u>Journal of Political Economy</u> **100**(3): 437-467

Chiappori, P. (1997). Collective Models of Household Behavior: The Sharing Rule Approach. <u>Intrahousehold Resource Allocation in Developing Countries: Models, Methods and Policy</u>. L. Haddad, J. Hoddinott and H. Alderman. Baltimore and London, International Food Policy Research Institute (IFPRI) and the John Hopkins University Press.

Chiappori, P. (1997). "Introducing Household Production in Collective Models of Labor Supply." <u>Journal of Political Economy</u> **105**(1): 191-209.

Chiappori, P., B. Fortin, et al. (1998). Household Labor Supply, Sharing Rule and the Marriage Market.

Farmer, A. and J. Tiefenthaler (1995). "Fairness concepts and the intrahousehold allocation of resources." <u>Journal of Development Economics</u> **47**: 179-189.

Lechene, V. and I. Preston (2008). Non cooperative household demand, THE INSTITUTE FOR FISCAL STUDIES.

Lundberg, S. and R. A. Pollak (1993). "Separate Spheres Bargaining and the Marriage Market." <u>Journal of Political Economy</u> **101**(6): 988-1010.

Lundberg, S. and R. A. Pollak (1994). "Noncooperative Bargaining Models of Marriage." <u>American Economic Review</u> **84**(2): 132-137.

Mani, A. (2010). Mine, Yours or Ours? The Effciency of Household Investment Decisions: An Experimental Approach, University of Warwick.

Manser, M. and M. Brown (1980). "Marriage and Household Decision Making: A Bargaining Analysis." <u>International Economic Review</u> **21**(1): 31-44.

McElroy, M. B. and M. J. Horney (1981). "Nash-bargained Household Decision: Towards a Generalization of the Theory of Demand." <u>International Economic Review</u> **22**(2): 333-349.

Sen, A. (1990). "Gender and Cooperative Conflicts", in I. Tinker, ed.,

Persistent Inequalities: Women and World Development, Oxford University Press, Oxford.

Udry, C. (1996). "Gender, Agricultural Production, and the Theory of the Household." Journal of Political Economy **104**(5): 1010-1046.

Appendix

Table A1: Efficiency tests: t-tests for male and female contribution rates being equal to 1 by treatment and region

Treatment no.	Amhara		Hadiya		Addis	
	Male	Female	Male	Female	Male	Female
1	-9.496	-11.398	-9.561	-8.708	-11.110	-11.000
2			-8.317	-7.271		
3			-10.926	-14.492		
4				-18.235		
5	-12.288					
6	-11.129	-17.432	-20.188	-13.153	-10.018	-15.244
7	-10.233	-13.869	-9.713	-9.199	-7.930	-8.062
8		-11.071				-9.802
9	-10.066					
10				-16.374		
11			-8.400			
12					-7.457	-7.319
13		-10.058				-8.563
14	-8.959					

Note: All p-values are 0.0000.

Table A2: Household random effects regressions on contribution rates

VARIABLES	(1) Coefficient	SE	(2) Coefficient	SE	(3) Coefficient	SE	(4) Coefficient	SE
Male	0.006	0.022	0.014	0.022	-0.023	0.028	-0.029	0.034
Age	-0.001	0.003	0.002	0.003	0.003	0.003	0.003	0.003
Age2	0.000	0.000	-0.000	0.000	-0.000	0.000	-0.000	0.000
Religion (Islam omitted)								
Orthodox	-0.034	0.038	-0.023	0.039	-0.024	0.039	-0.025	0.040
Protestant	-0.063	0.039	-0.058	0.040	-0.066	0.040	-0.066	0.041
Catholic	0.120	0.148	0.132	0.150	0.176	0.184	0.168	0.185
Main activities (working on farm omitted)								
Casual labour	-0.054	0.038	-0.038	0.040	-0.027	0.046	-0.029	0.046
Employee	-0.035	0.034	-0.040	0.035	-0.021	0.046	-0.021	0.047
Self-employed	-0.034	0.044	-0.041	0.045	-0.024	0.052	-0.028	0.053
Childcare/household chores	-0.041*	0.023	-0.031	0.023	-0.014	0.025	-0.017	0.026
Other	-0.071	0.046	-0.051	0.047	-0.022	0.053	-0.027	0.053
Educational level (not literate omitted)								
Only literate	0.024	0.030	0.022	0.030	0.030	0.031	0.029	0.031
1-6 yrs of education	0.078***	0.020	0.073***	0.020	0.077***	0.020	0.074***	0.020
7-12 yrs of education	0.127***	0.024	0.122***	0.025	0.128***	0.025	0.124***	0.026
More than 12 yrs	0.244***	0.059	0.248***	0.061	0.299***	0.065	0.291***	0.067
Mothers' main activity (working on farm omitted)								
Casual labour			-0.063	0.106	-0.078	0.108	-0.079	0.108
Employee			-0.030	0.051	-0.047	0.052	-0.046	0.052
Self-employed			-0.049	0.080	-0.086	0.086	-0.088	0.086
Childcare/household chores			-0.000	0.016	0.002	0.017	0.001	0.017
Other			0.083	0.080	0.085	0.085	0.084	0.085
Fathers' main activity (working on farm omitted)								
Casual labour			-0.067	0.062	-0.077	0.066	-0.079	0.067
Employee			0.041	0.030	0.045	0.031	0.045	0.031
Self-employed			0.075	0.050	0.096*	0.052	0.096*	0.053
Childcare/household			-0.059	0.120	-0.048	0.120	-0.042	0.120

VARIABLES	(1) Coefficient	SE	(2) Coefficient	SE	(3) Coefficient	SE	(4) Coefficient	SE
chores								
Other			-0.025	0.059	-0.014	0.059	-0.016	0.060
Time to mother's house (mother lives in the house is omitted)								
Less than a day			-0.052	0.043	-0.070	0.044	-0.078*	0.045
More than a day			-0.156**	0.076	-0.185**	0.076	-0.195**	0.077
Time to father's house (mother lives in the house is omitted)								
Less than a day			0.036	0.043	0.055	0.044	0.062	0.045
More than a day			0.130*	0.076	0.129*	0.076	0.136*	0.077
Parents alive?								
Father alive			0.021	0.017	0.014	0.018	0.015	0.018
Mother alive			0.026	0.016	0.024	0.017	0.022	0.017
How spend most of the day (work on farm omitted)								
Work on own business					0.002	0.038	0.003	0.038
Agricultural paid work					-0.035	0.088	-0.033	0.089
Non-agricultural paid work					-0.017	0.042	-0.017	0.042
Unpaid work					-0.052*	0.027	-0.051*	0.029
Who has most leisure time? (husband omitted)								
Wife					0.021	0.018	0.020	0.018
The same					-0.024	0.019	-0.023	0.019
Wife should tolerate beating (strongly agree omitted)								
Agree							-0.006	0.020
Disagree							0.015	0.025
Strongly disagree							0.009	0.025
Re-marriage index							0.002	0.018
Treatment and regional dummies included but not reported here								
Constant	0.552***	0.077	0.463***	0.085	0.465***	0.091	0.465***	0.108
Observations	1320		1301		1237		1230	
Number of hhunid2	882		873		853		851	

*** p<0.01, ** p<0.05, * p<0.1