

WIDER Working Paper No. 2013/012

Intra-household efficiency

An experimental study from Ethiopia

Bereket Kebede¹, Marcela Tarazona², Alistair Munro³, and
Arjan Verschoor¹

February 2013

Abstract

An experimental design using treatments of a voluntary contribution mechanism is used to test household efficiency. Efficiency is decisively rejected in all treatments contrary to the assumption of most household models. Information on initial endowments of spouses improves efficiency only in some treatments suggesting that the impact of information is context dependent. Actual and expected contribution rates of spouses are systematically different; husbands' (wives') expectations of their wives' (husbands') contributions are higher (lower) than actual contributions. These errors imply that equilibrium in a game theoretic framework is unlikely. Statistical tests indicate other considerations than efficiency are likely important.

Keywords: household efficiency, intra-household models, experimental games, Ethiopia
JEL classification: D13, C93, D03

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¹School of International Development and Centre for Behavioural and Experimental Social Sciences (CBESS), University of East Anglia, Norwich, emails b.kebede@uea.ac.uk (B. Kebede, corresponding author), a.verschoor@uea.ac.uk (A. Verschoor);² Oxford Policy Management (OPM), Oxford, email marcela.tarazona@opml.co.uk;³ National Graduate Institute for Policy Studies (GRIPS), Tokyo, email alistair-munro@grips.ac.jp

This study has been prepared within the UNU-WIDER project 'New Approaches to Measuring Poverty and Vulnerability', directed by Jukka Pirttilä and Markus Jäntti.

UNU-WIDER gratefully acknowledges the financial contributions to the research programme from the governments of Denmark, Finland, Sweden, and the United Kingdom.

ISSN 1798-7237

ISBN 978-92-9230-589-5



Acknowledgements

This study is part of a bigger inter-disciplinary project entitled ‘the intra-household allocation of resources: Cross-cultural tests, methodological innovations and policy implications’, covering Ethiopia, India, and Nigeria. An earlier draft of this study was supported jointly by the UK’s ESRC and DFID (RES-167-25-0251). The work has benefited greatly at all stages from the expertise and close co-operation of the other members of the team, Cecile Jackson and Nitya Rao, who provided extremely useful insights from sociological/anthropological perspectives. We are thankful to the hard-working efforts of our fieldwork manager, Matthew Osborne, and our local teams, Joe Hill, Sisay Hagos, and the research assistants who efficiently run the experimental games and household surveys in Ethiopia. The institutional support of the Ethiopian Economic Association (EEA) and its research wing the Ethiopian Economic Policy Research Institute (EEPRI) and its director, Dr Assefa Admassie, were instrumental for the successful completion of the fieldwork. Thanks also go to the married couples who participated in the games and household survey. We also acknowledge useful feedback from participants of the Annual Conference of the Centre for the Study of African Economies (CSAE) at Oxford University (March 2011), the Young Researchers Forum organised by the Scottish Institute for Research in Economics (SIRE) at Herriot-Watt University (March 2011), intra-household workshop at African Studies Centre at the Institute of Social Studies (ISS) in the Hague (February 2011), and UNU-WIDER Conference on ‘Poverty and Behavioural Economics’ (September 2011). The usual disclaimers hold.

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UNU World Institute for Development Economics Research (UNU-WIDER)
Katajanokanlaituri 6 B, 00160 Helsinki, Finland

Typescript prepared by Anna-Mari Vesterinen at UNU-WIDER.

The views expressed in this publication are those of the author(s). Publication does not imply endorsement by the Institute or the United Nations University, nor by the programme/project sponsors, of any of the views expressed.

1 Introduction

The household, with its myriad variations, is one of the most enduring and universal human institutions spanning vast expanses of historical time and geographical space. Many economic decisions that have far reaching consequences for the economy as a whole are made within households. Labour supply, saving and investment decisions, educational and health outcomes among others are significantly affected by choices made within households. Subsistence agriculture and home-based production makes household decisions even more important in the economies of developing countries. In spite of this, household economics is a relatively recent phenomenon. The seminal works of Becker (1965, 1973, 1974a, 1974b) and others spurred the development of formal household models in economics, most of which assume Pareto efficiency. In the unitary model, efficiency is attained mainly due to centralised decision-making¹ as a result of consensus and a household social welfare function (Samuelson 1956) or due a ‘benevolent dictator’.² In the Nash bargaining models (Manser and Brown 1980; McElroy and Horney 1981), even though bargaining power determines individual welfare, household welfare (measured by the Nash product of surplus from marriage) is maximised and hence efficiency attained. Collective models³ directly start from the assumption of Pareto and household efficiency is attained as a result of autonomous interactions between spouses. The distinguishing feature of all these models is that either an explicit or implicit income transfer occurs resulting in household Pareto efficiency (‘income pooling’ as in Apps and Rees 2009). In contrast, households may fail to attain efficiency in non co-operative models.⁴

Testing whether efficiency is attained can be done by analysing observational data. For example Udry (1996), using detailed survey data from Burkina Faso, found that the allocation of inputs on plots owned by wives and husbands is inefficient among agricultural households. While this approach is attractive since the efficiency of real life activity (farming in the case of Udry) is directly analysed, difficult identification problems should be faced. This is likely the main reason why other studies using similar data from the same country as Udry (1996) arrived at opposite conclusions (Akresh 2005, 2008). Alternatively, household efficiency can be tested using appropriately designed experimental games. While identification problems related to the analysis of real life activities is minimized by the experimental approach, external validity—whether behaviour in the ‘lab’ captures behaviour in real life—becomes a challenge. To strengthen external validity in this paper data from household surveys are used in conjunction with experimental results.

The use of experimental games to analyse intra-household issues is recently on the increase. Bateman and Munro (2005) and Munro et al. (2008) examine how decisions among spouses differ when made individually and jointly; they find that when spouses decide jointly they become more risk averse. Similarly, Carlsson et al. (2009) also found differences in risk preferences when spouses make decisions separately and together; the couples’ risk preferences become more similar the richer the spouses and the higher the relative income

¹ Pure altruism and identical preferences of individuals in the household can also be the bases for a unified household preference function.

² See Becker (1991) for his ‘rotten kid’ theorem, and Bergstrom (1989); Hirschleifer (1977), for critiques.

³ Chiappori (1988, 1992, 1997); Browning et al. (1994); Bourguignon et al. (1995).

⁴ Ulph (1988); Warr (1983); Woolley (1988); Lundberg and Pollak (1994); Lechene and Preston (2008); Browning et al. (2009).

contribution of the wives. Using Prisoner's Dilemma games, Cochard et al. (2009) show that even though co-operation among spouses is higher than that between strangers, generally spouses fail to attain the maximum level of efficiency. Ashraf (2009) looks at the effect of observability and communication on financial choices of married couples in the Philippines; when observed, particularly husbands are more willing to deposit their money in the account of their spouse. Mani (2010) showed that spouses from India are willing to sacrifice efficiency for the sake of control resources; spiteful and self-destructive behaviour by spouses can be better explained by factors like identity. Using a randomised field experiment in Kenya, Robinson (2008) rejected efficiency and found only limited insurance among married couples.

This paper follows and extends the work done in Iversen et al. (2006) and Iversen et al. (2011) to examine household efficiency among married couples by using different treatment of a voluntary contribution mechanism (VCM).⁵ In this framework, efficiency is measured by the degree of contribution towards the common pool. The paper extends the earlier work by a more comprehensive examination of potential factors related to household efficiency; here, issues that were not pursued earlier like the role of information, equilibrium behaviour, and other motives like fairness, are covered with more treatments and a larger sample size. In all the efficient household models either implicitly or explicitly perfect information is assumed; the potential effect of asymmetric information is rarely examined. Endowments and control allocation can also have a bearing on efficiency. For example, in the unitary model control by the benevolent dictator helps the attainment of household efficiency. The experimental design used in this paper allows us to systematically vary the amounts of endowments and control over allocations to address these questions. While in some treatments both husbands and wives are given equal endowments, in others only one spouse is given all the endowment. Similarly, while in some treatments the total pooled contribution is divided equally between the two spouses, in others husbands and wives alternatively decide on its allocation. In addition, this paper examines the difference between actual and expected behaviour of spouses shading light on equilibrium in a game theoretic framework. This comprehensive exploration of many aspects of household efficiency was made possible due to the implementation of an improved experimental design with many treatments, a comprehensive survey, and large sample size.

The analyses that combine both experimental and household survey data provide many interesting results that have far-reaching implications for household models. Efficiency is decisively rejected in all treatments casting doubt on the assumption of Pareto efficiency. Interestingly efficiency is rejected whether initial endowments are equally split between spouses or only one spouse takes all. Efficiency is also rejected with all variations in allocations whether the household common pool is split equally between spouses or allocated by husband or wife. Information on initial endowments improves efficiency in some treatments while having no effect in others, suggesting that the role of information is context dependent. Actual and expected contribution rates of spouses are systematically different; husbands' expectations of their wives' contributions are *higher* than actual contributions and wives' expectations of their husbands' contributions are *lower* than actual contributions. 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 other considerations than efficiency, like fairness or similar norms, are likely important. Overall,

⁵ Related papers from the same research group are Munro et al. (2010) and Munro et al. (2011); the first of which looks at intra-household allocations in India and the second at polygamous households in Nigeria.

most of the empirical results cast doubt on co-operative models and provide some support for behaviour guided either by fairness or other norms.

The rest of the paper is organised in the following way. The next two sections present the experimental design and the fieldwork. After discussing the main experimental results in Section 4, econometric analyses of experimental and household survey data are presented in Section 5. The final section presents concluding remarks.

2 Experimental design

Fourteen treatments of a basic VCM were played with variations in endowments, control of allocation, and information.⁶ Like the standard VCM, individuals contribute to a common pool which is increased and distributed among the contributors. But unlike most VCMs played among anonymously matched individuals, here the games are played between spouses. The following three treatments are implemented in all three sites to capture the effects of variations in the control of allocation:

Investment baseline (treatment 1): Each spouse separately and privately receives an endowment of Birr 40.⁷ Each then chooses an investment from the set (0, 10, 20, 30, or 40). The investments of the two spouses are added and multiplied by 1.5 and then each player receives half of the total.

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.

Male control (treatment 7): Like female control except that husbands control allocation.

In treatment 2 (named all to men) each subject separately and privately receives Birr 40 and makes an investment decision from the same choice set indicated above. The investments are summed and multiplied by 1.5 and all the money is given to the husband. In the treatment 3 (all to female) all the common pool is given to the wife; in these two versions spouses do not allocate the common pool. In treatment 4 (5), treatment named female (male) endowment, only the wife (husband) gets Birr 80 (the other spouse gets nothing). After contribution and multiplying by 1.5, the common pool is divided equally between the two. Treatments 8 and 9 are variations of trust game.⁸ In treatment 8 (9), 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

⁶ In addition, five more treatments that include production were also played; these games are not included here since they are significantly different in nature from the games without production.

⁷ Birr is the national currency of Ethiopia and during the time of the survey US\$1 was worth around Birr 11.

⁸ Even though we call these games trust games because of their apparent similarity of the game with the same name, there is a fundamental difference. In the standard trust game, the trustee is anonymous for the trustor; since in these games the trustee is his/her spouse, some of the allocation can be undone after the game. For the lack of a better name, we still call these games trust games but this fundamental difference should be noted.

pool is also decided by the wife; similarly, in treatment 11 (male dictator), all endowment is given to the husband and allocation is also done by the husband.

In all the treatments described above, the endowment to each spouse was given privately whereas the amount in the common account and how it will be allocated was common knowledge. For example, we told male 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.’

Full information was not revealed to mimic asymmetric information between spouses in real life (Pahl 1990). To examine the effect of information, three 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 male trust respectively) are like the trust games (treatments 8 and 9) but with full information (look at Table 1 for a summary of the treatments).

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

Source: Primary data from research project.

3 Data collection

This research is part of a larger project covering Ethiopia, India, and Nigeria. The fieldwork in Ethiopia was implemented in one urban and two rural sites between March and June 2009, with a total of 1,200 married couples. While Addis Ababa, the capital city, is the urban site, Mehal Meda and Hadiya zones which are north-east and south-west of Addis Ababa respectively, are rural. In each site, five locations were selected. In the case of rural areas, these five locations were distinct villages pre-selected in the month leading up to the main fieldwork using local informants and prior visits. Size (80 couples should be recruited from each) and geographical separation from each other (to limit cross-contamination) were two of the selection criteria. The experiments in each site were done in five consecutive days, going to one site in one day and playing different treatments in the mornings and afternoons to avoid contamination.

The rural sites capture important differences in farming systems and ethnic composition. The northern site, populated by the second largest ethnic group (the Amhara) is characterised by the cultivation of cereals, the use of ox-plough, and centralised control of agriculture by the male household head. In contrast, the southern site is inhabited mainly by a minority ethnic group (the Hadiya) and is characterised by hoe farming and the cultivation of perennial crops with stronger involvement of females in the management of the staple crop. In Addis Ababa the experiments were run in five different *kebeles*.⁹

In each location, prior visits were made and lists from local authorities were used as sampling frames to randomly selected 90 households per location, ten of which as reserves. Six female and six male research assistants run the experiments after receiving five days of training and a pilot. The experimental scripts were translated into the local language by an experienced translator and thoroughly checked. In the 15 locations, community centres, schools, or farm buildings were used as venues. 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, with the remainder left for the common account. In the case of treatments with public information, spouses were told how much the other received. The research assistants collected back the envelopes and recorded the decisions. At the end, envelopes were matched and couples were paid in private.

Few days after the experimental games, the players were covered by comprehensive household surveys with separate questionnaires for wives and husbands. These surveys provide a rich data set on the socio-economic variables. In addition, detailed qualitative data on intra-household allocations and norms of conjugality were also collected from a sub-set of the participants.

The experimental games are of relatively simple design but due to the low level of education and the unfamiliar nature of the exercise, much care was taken to be sure that participants understood instructions. The instructions in the local language were read before the start of the games, questions and more explanations were given to those that did not correctly answer. In addition, debriefing of a sample of participants after the game clearly indicated that most had understood the games.

⁹ *Kebele* is the lowest administrative sub-division in Ethiopia. In rural areas, *kebele* is also known as Peasant Association.

4 Experimental results

This section focuses on three issues. First, tests of efficiency are conducted. Second, whether other concerns than efficiency are important, is explored. Third, actual and expected contributions are compared to examine if players' behaviour exhibit an equilibrium characteristic.

Note that for an efficient outcome the common pool should be maximised and for that spouses should contribute all their initial endowments. Hence, the test for efficiency is a test of whether contribution rates—percentages of endowments contributed—are equal to 1 (100 per cent).

Table 2: Mean male and female contribution rates

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

Source: Primary data from research project.

Table 2 presents the mean contribution rates. It is apparent that contribution rates are much lower than 100 per cent with an overall average of 56 per cent. On the average, males contribute more than females and contribution rates are highest in the urban site followed by the southern site. Across treatments, contribution rates range between 70 per cent (males in treatment 12) and 40 per cent (females in treatment 4). This significant variation is observed even if contribution rates are disaggregated by regions, implying that the variation is not driven by regional differences. Statistical tests also confirm that contribution rates are significantly lower than 100 per cent (see Table 3). At both aggregated and disaggregated levels (by regions and treatments) the null hypotheses that contribution rates equal 100 per cent are decisively rejected without exception. These results strongly show that the spouses consistently failed to realise all potential surplus in all treatments and in all regions. At the mean contribution rate of 56 per cent from the total amount of money all players could have taken home, they left around 15 per cent with the researchers.

Table 3: 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	-39.255	-21.985	-45.401	-22.821		
	Overall					
	By region					
Amhara	-24.910	-13.173	-27.290	-12.165		
Hadiya	-24.576	-13.215	-29.687	-14.308		
Addis	-18.873	-11.625	-23.184	-13.008		
	By treatment					
1	-17.270	-9.329	-17.791	-9.330		
2	-8.317	-5.168	-7.271	-4.828		
3	-10.926	-5.457	-14.492	-5.589		
4			-18.235	-5.565		
5	-12.288	-5.524				
6	-21.326	-9.567	-24.309	-9.581		
7	-15.874	-9.120	-17.208	-9.179		
8			-14.705	-7.605		
9	-11.603	-7.417				
10			-16.374	-5.536		
11	-8.400	-5.323				
12	-7.457	-4.963	-7.319	-5.017		
13			-12.972	-7.454		
14	-8.959	-5.310				
	By region and treatment (t-stat)					
	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: The null hypotheses of the tests are that contribution rates are 100%. All p-values are 0.0000.
Source: Primary data from research project.

The strong statistical results indicate the failure to attain efficiency even in a single treatment despite all the variations in endowments, control of allocation and information. This implies intra-household inefficiency; spouses left money on the table.

Result 1: In all regions and treatments the test in which players contribute everything to the common pool is decisively rejected and hence significant amount of potential surplus remained unrealised suggesting intra-household inefficiency.

Table 4 presents statistical tests for equality of male and female contribution rates for those treatments where both women and men have equal endowments. Differences are significant

in only two cases—treatments 6 and 7—and in both males contribute more. These results provide a rather weak evidence for gender differentiation in contribution behaviour.

Table 4: 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	-3.862	0.0001	-3.115	0.0018	Male
Treatment 1	-0.861	0.3912	-0.827	0.4080	
Treatment 2	0.443	0.6604	0.331	0.7409	
Treatment 3	0.000	1.0000	0.222	0.8240	
Treatment 6	-3.141	0.0021	-3.071	0.0021	Male
Treatment 7	-2.813	0.0057	-2.378	0.0174	Male
Treatment 12	-0.255	0.7999	-0.162	0.8711	

Note: The null hypotheses of the tests are that contribution rates are 100%
Source: Primary data from research project.

Result 2: In the majority of cases there are no significant differences between male and female contribution rates; in the small number of cases where contribution rates are significantly different, males contribute more than females.

Variations in male and female contribution rates can be examined in a different way. To avoid potential confounding regional effects, differences in male and female contribution rates between similar games played in the same region can also be used. 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 without confounding the results with regional variations. Both parametric and non-parametric tests in Table 5 indicate that male contribution rates in treatment 9 (male trust) are significantly higher than female contribution rates in treatment 8 (female trust). This reinforces the previous result that if there are differences, males generally contribute more.

Result 3: The results from the trust games indicate that male contribution rates are higher than that of females (reinforcing Result 2).

Table 5: 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.

Source: Primary data from research project.

To examine both, urban-rural and rural-rural differences, statistical tests on wives' and husbands' contribution rates in each region compared to the other two, are conducted (see Table 6). 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 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

results for treatments played in all the three sites. Male and female 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 per cent level with contribution rates being highest in Addis Ababa and lowest in Amhara. These results imply that regional differences are small and existing differences are explained mainly 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 indicated previously, in all except treatments 13 and 14, initial endowments were private. One would expect that public information will encourage co-operation and increase contributions as it raises the cost of hiding from a spouse. Table 7 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 regional effects. The comparisons of male and female contribution rates in treatments 1 and 12 provide rather weak evidence (significant at 10 per cent level) that, as expected, information increases contribution. 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 likely mediated by the specific context in which more information is revealed. Public information automatically does not guarantee increases in efficiency let alone full efficiency—note that even in those treatments where endowments are public, contribution rates are far below 100 per cent.

Result 5: In the investment baseline both male and female contribution rates weakly increase with public information of initial endowments. But in trust games, contribution rates of both are not sensitive to public information.

Table 6: 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	3.330	0.0009	4.683	0.0000
Hadiya	0.599	0.531	-0.370	0.7114	0.503	0.6152
Addis Ababa	0.643	0.608	-3.098	0.0020	-4.987	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	0.857	0.3931	1.607	0.1107
Hadiya	0.6625	0.6438	-1.527	0.1295	-1.673	0.0970
Addis Ababa	0.5938	0.5875	0.659	0.5115	0.064	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	-0.636	0.5263	4.336	0.0000
Hadiya	0.5375	0.4938	0.636	0.5263	-0.808	0.4209
Addis Ababa	0.5563	0.5688	0.000	1.0000	-3.374	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	1.881	0.0625	2.316	0.0223
Hadiya	0.6313	0.5375	-0.930	0.3543	-0.422	0.6740
Addis Ababa	0.6313	0.5938	-0.930	0.3543	-1.871	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.

Source: Primary data from research project.

Table 7: The role of information role of information

Treatment	Mean contribution	Male contribution			
		t-stat	t-test p-value	Mann–Whitney test	
		For Addis Ababa only		z-stat	p-value
1 (investment baseline)	0.5938	-1.954	0.0542	-1.756	0.0791
12 (public endowments)	0.7000				
		For Amhara only			
9 (male trust)	0.5781	1.239	0.2192	1.419	0.1560
14 (public male trust)	0.4906				
		Female contribution			
		For Addis Ababa only			
1 (investment baseline)	0.5875	-1.760	0.0824	-1.759	0.0787
12 (public endowments)	0.6875				
		For Amhara and Addis Ababa only			
8 (female trust)	0.5531	0.034	0.9730	0.230	0.8179
13 (public female trust)	0.5516				

Source: Primary data from research project.

In equilibrium, in a classic game theoretic set-up, mutual expectations of players should be an accurate reflection of actual behaviour: ‘In equilibrium players are never surprised by what other players do’ (Camerer 2010). Whether the spouses had on the average accurate expectations of each others behaviour in the experimental games, is an important indication of equilibrium behaviour which 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 8). In all cases, equality is strongly rejected. In addition it is interesting to note that the errors in the expectations of husbands and wives are opposite. While wives’ expectations of the amounts husbands will keep are significantly higher than what husbands actually keep; husbands’ expectations of the amounts wives will keep is significantly lower than what wives actual keep. In other words, wives significantly underestimate the amounts their husbands contribute to the common pool and husbands significantly overestimate the amounts their wives contribute.

Table 8: Actual and expected amounts kept by spouses

Actual amount kept by husband	19.387		
Expected amount by wife	21.687		
		t-stats	p-value
t-test		-3.621	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		3.426	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.

Source: Primary data from research project.

Table 9: Actual contributions by husbands and wives' expectations 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	-5.322	0.0000	-4.712	0.0000
Expected amount by wife	21.50				
Treatment 2					
Actual amount kept by husband	13.50	-1.350	0.1848	-1.542	0.1230
Expected amount by wife	16.00				
Treatment 3					
Actual amount kept by husband	19.75	-2.395	0.0215	-2.395	0.0166
Expected amount by wife	24.75				
Treatment 6					
Actual amount kept by husband	17.75	-3.259	0.0015	-2.944	0.0032
Expected amount by wife	21.17				
Treatment 7					
Actual amount kept by husband	16.05	-4.377	0.0000	-3.430	0.0006
Expected amount by wife	22.61				
Treatment 9					
Actual amount kept by husband	27.34	4.100	0.0001	3.539	0.0004
Expected amount by wife	17.62				
Treatment 11					
Actual amount kept by husband	32.5	2.855	0.0069	2.538	0.0111
Expected amount by wife	21.00				
Treatment 12					
Actual amount kept by husband	12.00	-2.940	0.0055	-2.613	0.0090
Expected amount by wife	19.50				
Treatment 14					
Actual amount kept by husband	40.75	-0.667	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.

Source: Primary data from research project.

The figures reported in Table 8 are aggregate figures for all games; Tables 9 and 10 provide results for each treatment. Except two cases for husbands and four for wives, all the rest are significantly different at least at 10 per cent level, i.e., actual behaviour of players are significantly different from what their spouses expect. In addition, more or less patterns observed at the aggregate level repeat. With respect to husbands' contributions and their wives' expectations, in eight out of the ten significant cases, expected amounts are higher than actual amounts; husbands contribute more to the common pool than their wives expect. The results for wives' contributions 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.

These systematic differences in expectations and actual behaviour imply that the attainment of equilibrium is unlikely. We expect players to attain more convergence between expected and actual behaviour in repeated games. But note that the players in our experimental games are real married couples that have lived together, some for a very long period of time; these systematic differences in actual and expected behaviour are among people that are already in repeated interactions.

Table 10: Actual contributions by wives and husbands' expectations 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	-2.086	0.0392	-1.880	0.0601
Expected amount by husband	19.08				
Treatment 2					
Actual amount kept by wife	12.75	-2.796	0.0080	-2.243	0.0249
Expected amount by husband	21.00				
Treatment 3					
Actual amount kept by wife	19.75	-0.393	0.6964	-0.760	0.4475
Expected amount by husband	20.50				
Treatment 4					
Actual amount kept by wife	47.75	9.469	0.0000	5.196	0.0000
Expected amount by husband	19.75				
Treatment 6					
Actual amount kept by wife	21.17	1.474	0.1432	1.742	0.0815
Expected amount by husband	19.5				
Treatment 7					
Actual amount kept by wife	19.17	1.253	0.2127	1.534	0.1250
Expected amount by husband	17.5				
Treatment 8					
Actual amount kept by wife	35.75	4.013	0.0001	3.886	0.0001
Expected amount by husband	23.63				
Treatment 10					
Actual amount kept by wife	43.75	8.542	0.0000	5.179	0.0000
Expected amount by husband	18.00				
Treatment 12					
Actual amount kept by wife	12.5	-2.023	0.0499	-1.885	0.0595
Expected amount by husband	17.25				
Treatment 13					
Actual amount kept by wife	35.88	-0.077	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.

Source: Primary data from research project.

Result 6: The actual and expected contribution behaviour of spouses is significantly different from each other. Wives contribute less than what their husbands expect and husbands contribute more than what their wives expect.

The distribution of contribution rates reveals an interesting pattern. Figures 1 and 2 present the histograms of male and female contribution rates respectively. In all cases, it is apparent that the mass of the distributions is concentrated around the middle, giving the impression that players may be following other rules than attempting to maximise surplus. To formally examine whether contribution rates converge to specific values other than 1 (100 per cent), a series of tests were conducted. Note that contributions are made from the set of (0, 10, 20, 30, and 40) for endowment of Birr 40 and from the set of (0, 10, 20, 30, 40, 50, 60, 70, and 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 contributions are equal to each of these rates was tested. Invariably these were almost always rejected for other contribution rates than 0.5; the tests for rates being equal to 0.5 are given in Table 11.

Figure 1: Histograms of male contribution rates by treatment



Source: Primary data from research project.

Figure 2: Histograms of female contribution rates by treatment



Source: Primary data from research project.

The null hypotheses that contribution rates are equal to 0.5 are accepted (at 5 per cent) for ten 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 may reflect fairness or similar norms ‘spouses should contribute half of their money to the household’. A contribution rule that divides endowments into equal halves to the individual and household has a much better predictive power than surplus maximisation.

Table 11: T-tests for contribution rates being equal to 0.5

Treatment number	Male		Female	
	t-stat	p-value	t-stat	p-value
1	5.134	0.0000	3.883	0.0002
2	4.005	0.0003	4.134	0.0002
3	0.138	0.8907	0.183	0.8554
4			-2.960	0.0052
5	0.571	0.5715		
6	2.703	0.0079	-1.430	0.1554
7	3.866	0.0002	0.748	0.4558
8			1.748	0.0843
9	5.274	0.0000		
10			-1.404	0.1684
11	1.939	0.0598		
12	4.971	0.0000	4.392	0.0001
13			1.492	0.1398
14	-0.165	0.8699		

Source: Primary data from research project.

Result 7: Half of the contribution rates of spouses are not statistically different from 50 per cent.

The main experimental results are presented. In the next section, the relationship between contribution behaviour in the games and socio-economic characteristics of households are examined.

5 Household efficiency and socio-economic characteristics

The household survey covered characteristics of individuals such as age, education, main occupation as well as 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. The mean values of variables used in the analyses in this section are given in Table 12.

The average age of participants is around 40 years but it ranges from a low of 16 to a high of 95. The respective mean ages of wives and husbands are 35 and 43 years; like in other countries men usually marry younger females. This age difference presumably can be significant in intra-household allocations since, like in many developing countries, respect to elders is important in Ethiopia. Around two-thirds of the individuals are followers of the historically dominant Ethiopian Orthodox Christian church. Compared to the total population of the country, the sample over-represents the Orthodox and Protestant churches while 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 mainly for females. There is a strong gender division of labour; while around 20 per cent and 67 per cent of females respectively reported farming and childcare/household chores as their main activity, the corresponding figures for males are 66 per cent and 4 per cent. The information on main activities also shows the limited opportunities for non-farm activities, for example, less than 4 per cent of the participants from rural areas reported casual labour, employee, self-employed, and other main activities.

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

Source: Primary data from research project.

Educational levels are very low with 73 per cent of the players having at most six years (primary level) of education. Both rural-urban and male-female differences in education are significant. For example, while 83 per cent of the urban players have at least six years of education, the figure falls to 50 per cent for rural sites. The corresponding figures for males and females are 80 per cent and 59 per cent. The main activities of the parents of the participants are very similar to the participants. The similarity in the occupations of two generations highlights the lack of structural transformation in the economy. While around 27 per cent of the fathers and mothers of the husbands live with them, the figure falls to 7 per cent for wives, reflecting the patrilocal nature of most marriages in Ethiopia. But this difference almost completely disappears in the urban site; while the proportion of wives living with their parents is 8 per cent, the figure for husbands is only 11 per cent (the corresponding figures for rural areas are 6 per cent and 35 per cent). More than half of the parents of the spouses are alive. Interestingly, more mothers than fathers are alive for both

husbands and wives ($t = -14.2441$; $p = 0.0000$); this likely reflects on the one hand that females marry younger than men and on the other, that life expectancy of women is higher than men. 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).

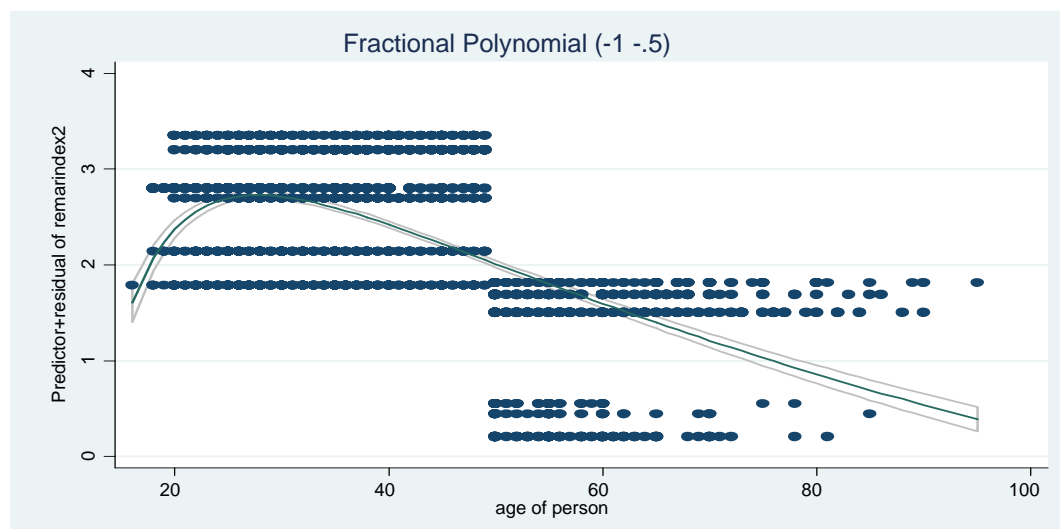
Around half of the marriages are ceremonial and registered. It is interesting that the second most frequent type of marriage is living together. Living together is mainly an urban phenomenon; from the urban sample, while 48 per cent are living together, the figure drops to 26 per cent for rural sites. In terms of allocation of time, as expected, most time is used either on the farm or in the form of unpaid work like household chores and childcare. While 70 per cent of females reported they spend most of the day doing unpaid work, 65 per cent of males are working on farm—again a reflection of the gender division of labour. In rural sites, 58 per cent and 2 per cent of spouses devote most of the day on farm or paid work respectively; these figures change to less than 1 per cent and 39 per cent for the urban site.

Domestic violence and how much people are acclimatized to it are important for intra-household relationships. Respondents were asked whether they strongly agree, agree, disagree, or strongly disagree with the statement ‘Wives should tolerate beating to keep family together’. Around 58 per cent of the respondents either strongly agreed or agreed with the statement. The figure for rural areas increases to 64 per cent while that for Addis Ababa is 47 per cent. More interestingly, disaggregated responses by sex show that a staggering 77 per cent of the females but only 39 per cent of the males either strongly agree or agree with the statement.¹⁰ 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 12 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 and females in a certain age group to remarry in the community. Four age groups were used: 25 years or younger, 25-35, 35-50, and older than 50. 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 for ‘they never remarry’ and 4 for ‘remarry in one year or less’. These responses are averaged for age-sex groups at the site—i.e., for a specific age-sex group there is only one remarriage index in a site. 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—as expected older people have less chance of remarrying. To examine whether there are nonlinear effects, fractional polynomial regression of the remarriage index on age was done; Figure 3 presents the fractional polynomial plot. First, 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. As an outside option, if remarriage potential influences intra-household allocations as argued by intra-household models, males will have an advantage with higher remarriage potential.

¹⁰ The relatively low percentage for males may be due to social desirability bias, i.e., men pretending to be against domestic violence. It seems there is no similar apparent reason why we should suspect the 77 per cent for females is biased upwards.

Figure 3: Age and remarriage index



Source: Primary data from research project.

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 in a multivariate framework if these socio-economic characteristics are systematically correlated to behaviour in the games. For the multivariate analysis, contribution rates are regressed on socio-economic characteristics of households. If Y_{ij} stands for contribution rates, X_{ij} and Z_j for individual and household level socio-economic characteristics of individual i in household j , the regression estimated is in the form

$$Y_{ij} = \beta_0 + \beta_1 X_{ij} + \beta_2 Z_j + \epsilon_j + \mu_{ij}$$

Here, the β s are estimated parameters and ϵ_j and μ_{ij} are household level and individual level unobservables. An endogeneity problem is expected in estimating this regression because the household level unobservables are expected to be correlated with included household variables ($cov(Z_j, \epsilon_j) \neq 0$). To control for this, household fixed effects estimates are used which are made possible since for each household two spouses are observed. The results from four versions of household fixed effects regressions are reported in Table 13; subsequent columns control for more variables to examine if results are robust to the inclusion of variables. In all the four cases, the Hausman specification tests support the household fixed effects models.

Even though the fixed effects model mitigates the problem of endogeneity, this is achieved at a cost; variables that do not vary between spouses will be absorbed in household fixed effects. For this reason, the discussion of results from fixed effects regressions will be complemented by those from household random effects regression results to particularly examine those variables that are either completely or nearly fixed on the household level. The random effects results are given in Table A1 in the Appendix.¹¹

¹¹ In addition, Tobit random effects models were estimated to examine if censoring significantly affects results; since the level of censoring is rather low, the Tobit random effects estimates are virtually the same as the household random effects estimates.

Table 13: Household fixed effects regressions of contribution rates

VARIABLES	(1)		(2)		(3)		(4)	
	Coefficient	SE	Coefficient	SE	Coefficient	SE	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	
Hausman test								
Chi square	43.42		56.12		67.39		81.50	
P-value	0.0001		0.0018		0.0008		0.0005	
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

Source: Primary data from research project.

We have seen that, 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 per cent) in only one case; gender does not seem to be an important determinant. Age is more significant than gender with contribution rates increasing with age but with a possibly small diminishing effect. It is interesting to note that age is not significant in the random effects model implying correlation between age and unobserved household fixed effects is likely important.

Result 8: While gender is not an important correlate, there is a positive correlation with age with some weak diminishing effects.

Interestingly, the coefficients on Protestants are significant (at least at 10 per cent) and negative implying contribution rates by Protestants on the average are lower by between 12 per cent and 18 per cent when they are married with a spouse of a different religion; this is a relatively high magnitude. Note the coefficients in the random effects models are not significant; the combination of the two results imply that Protestants contribute lower only when they are married with a spouse from a different religion.

Result 9: The contribution rates of Protestants are lower compared to followers of other religions particularly when they are married to a spouse from a different religion.

Even though in all the random effects regressions main activities are not significant, in the household fixed effects some are,¹² and 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, controlling for other variables. Compared to other occupations, farming requires more co-operation between spouses where they engage in relatively clearly defined but very complementary agricultural tasks determined by traditional division of labour. For example, while men are responsible for ploughing and sowing, women play a more important role in weeding and caring for *enset*¹³ (in the southern regions). The other occupations usually do not 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). These factors are the likely explanation for higher levels of co-operation among spouses involved in agricultural activities.

Result 10: Those mainly engaged in farming activities contribute at least the same or more than those in other occupations.

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 may be influenced by education and can increase co-operation. The random effects regression results strongly support this. First, those that have at least one year of education significantly (at 1 per cent level) contribute more compared to illiterate people. Second, the coefficients on higher levels of education are consistently higher than lower levels of education. For

¹² 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’.

¹³ *Enset* is the ‘false banana’ (*enset ventricosum*) tree which is used as a staple food in many areas of southern Ethiopia.

example, in model 1, those with one to six years of education contribute 7.8 per cent higher than illiterate or just literate people; those with seven to twelve and more than twelve years of education respectively contributed 12.7 per cent and 24.4 per cent (all highly significant at 1 per cent level). All these results collapse when controlling for household level fixed effects. One potential reason for this is similarity in the educational levels of husbands and wives (assortative matching). If the educational level of husbands and wives are similar, within household variation in education is very low and will not be captured when household fixed effects are controlled for. But as discussed previously, educational attainments between males and females are significantly different.¹⁴ The more plausible interpretation is that even though education is likely to play a positive role in increasing contribution rates, education itself is probably correlated to unobservable household fixed effects that increase contribution rates.

Result 11: More educated people contribute more but this is likely confounded by other unobservable household fixed effects correlated to education.

Almost all the other variables included in the regressions are not significant. To examine whether some of the variables have gender or age specific effects, variables were interacted with the male dummy or age respectively. Interactive terms with gender and age were not significant. 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, the main activities of parents are not significant. To examine the importance of support from parents, whether parents are alive was entered, but it is not significant. Contribution rates are also uncorrelated to distance to mothers' and fathers' residences. Reinforcing the previous result that farming encourages co-operation, there is some indication that people who devote most of their time to non-agricultural activities contribute less.

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 per cent). This gives the impression that spouses who do not tolerate wife beating are more co-operative; but this interpretation is undermined by the non-significance 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 per cent and the interactive term between 'disagree' and the male dummy becomes significant at 10 per cent *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 affecting the behaviour of wives in household investment.

Result 12: Women who are against wife beating contribute more compared to women who tolerate it.

The remarriage index is not significant as is or when interacted with the gender dummy. But interestingly when interacted with age, not only the interactive term but also the main term becomes significant. 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

¹⁴ Tests for equality of educational levels of husbands and wives are strongly rejected ($t = -10.0210$; $p = 0.0000$).

are less co-operative 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 contribute less to the common pool. This effect is attenuated by age.

6 Conclusions

A common feature of intra-household models that assume Pareto efficiency is the assumption that household members either explicitly or implicitly make transfers of income between themselves to attain efficiency on the household level (the assumption of ‘income pooling’ as in Apps and Rees 2009). Given heterogeneity between households this implies that whatever the initial endowment of individual spouses and whatever the household allocation rule, married couples will exploit opportunities to maximise household surplus. Our experimental design directly tests this by using treatments that vary initial endowments and final allocation in a VCM. In all the variants and in all research sites, efficiency is strongly rejected. This result is highly unlikely to be driven by misunderstanding of players since the utmost care was taken both in providing clear instructions as well as giving additional explanations for those who did not understand the instructions. Discussions after the games clearly indicated that the spouses have understood the implications of their decisions and are aware that they are forfeiting money by not contributing all their endowments. The main motive for keeping some of their endowments rather than contributing to the common pool seems to be the security of retained money (as indicated in a similar research in Uganda in Jackson 2009). Asymmetric information, in the form of treatments that do not reveal the exact amount of initial endowments of the other spouse, is also not the reason for inefficiency because, as reported, treatments with full information were also characterised by less than 100 per cent contributions. This is a clear experimental evidence against an ‘income pooling’ mechanism as suggested by Pareto optimal intra-household models.

The experimental results also indicate that 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 contributions. These systematic errors in expectations imply that the attainment of equilibrium in a game theoretic framework is unlikely. The repeated nature of existing long-term relationship between spouses in the real world implies that, even if the games are repeated, convergence towards equilibrium is unlikely to emerge.

The analysis of experimental data in conjunction with individual and household socio-economic characteristics reveals many interesting results. For example, households mainly engaged in farming contribute more. This is likely because of the highly complementary nature of agricultural tasks which require higher levels of co-operation. Incidentally, the results from the analysis indicate that the performance of spouses differs depending on their socio-economic characteristics. This heterogeneity is not incorporated in dominant intra-household models.

In many of the treatments, spouses contributed around half of their endowments; the predictive power of a model which assumes that spouses will contribute half is better than

that based on efficiency. It seems most players were following a norm ‘contributing to the household half of what you get is a fair deal’.

The results from this paper imply that the explanatory power of intra-household models based on Pareto efficiency is likely limited. More focus on non co-operative models and intra-household allocations based on fairness or similar social norms is likely a more fruitful avenue of research.

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Appendix

Table A1: Household random effects regressions on contribution rates

VARIABLES	(1)		(2)		(3)		(4)	
	Coefficient	SE	Coefficient	SE	Coefficient	SE	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 chores			-0.059	0.120	-0.048	0.120	-0.042	0.120
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	

Note: *** p<0.01, ** p<0.05, * p<0.1

Source: Primary data from research project.