Inefficient Intra-Household Allocation under Asymmetric Information in Ghana

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Abstract:

We report results from a year-long field experiment in southern Ghana in which individual household members had the opportunity to win a windfall in public or in private. We use the experiment to answer the following questions: Can individuals in established married couples allocate resources efficiently under asymmetric information? and Do spouses allocate resources that are common knowledge differently from money obtained in private? Eastern Ghana is an ideal setting for analyzing intra-household resource allocation because of the extent to which the marital contract seems to deviate from the standard unitary model. We first examine whether married couples allocate resources efficiently by testing for unitary and collective rationality in spousal expenditure. We find that intra-household allocation is not consistent with either unitary, collective rationality, or full insurance. Interestingly, results suggest that asymmetric information is not the cause of the inefficiency in spousal expenditure because observable windfalls are also not allocated efficiently. Windfalls won in private are transferred to other households in the form of gifts, suggesting that spouses commit the prizes in order to exercise discretion over how to spend it in following rounds on children, for instance. Therefore, even though intra-household allocation is not Pareto efficient, asymmetric information over windfalls allows spouses to make investments in social capital through gifts, and to maintain discretion over how the money is spent.

JEL Classification: D13, D82, J12.

I. Introduction

The allocation of resources within the household has historically been viewed as either the decision of a single household member (unitary or common preference model, Becker (1981)) or the result of a cooperative decision among the collective of household members (Browning and Chiappori, 1998; Manser and Brown, 1980; McElroy and Horney, 1981). It is often argued that, because of caring and long-term, repeated interactions within families, households recognize opportunities for Pareto improvement by pooling income in equilibrium. Evidence from developed countries supports the efficiency hypothesis (Chiappori et al., 2002; Bourguignon et al., 1993; Thomas and Chen, 1994). In developing countries, however, the evidence is mixed. Bobonis (2009) among households in Mexico who benefited from PROGRESA, as well as LaFave and Thomas (2014) in Indonesia, find households allocate resources efficiently. However, recent empirical evidence has increasingly documented instances of inefficient allocations and non-cooperative behavior, both under complete information (Udry, 1996; Duflo and Udry, 2003; Robinson, 2012; among others [2]), and under asymmetric information within the household (Chen, 2009; Ashraf, 2009; Schaner, 2015; Kinnan, 2014; Castilla and Walker, 2013; Hoel, 2012; Ashraf, Field and Lee, 2010).

In this paper, we report results from a year-long field experiment in southern Ghana in which individual household members had the opportunity to win a windfall in public or in private. We use the experiment to answer the following questions: Can individuals in established married couples allocate resources efficiently under asymmetric information? and Do spouses allocate resources that are common knowledge differently from money obtained in

[2] Kebede et al. 2013; Munro et al. (2008a; 2008b); Munro et al. 2011; Castilla, 2015; Cochard et al. 2009; Iversen et al., 2010

private? When intra-household allocation is cooperative, asymmetric information is inconsequential as spouses can either directly or through the expenditure process inform each other about the presence of additional resources. In contrast, when spouses behave non-cooperatively public transfers have differential effects on expenditure relative to transfers obtained in private, resulting in efficiency losses.

We test these predictions using a field experiment and survey data collected between March and October 2009 in four communities in Akwapim South district of Ghana's Eastern Region, in which subjects participated in a lottery. The lottery was a two-by-two design, with half of the prizes awarded in public (in front of the entire village), and half awarded in private. Half of the prizes were cash, and the other half were livestock (chickens and goats) of equivalent value. The experimental design is well suited to test for efficiency because husbands and wives from each household had an equal and independent probability of winning a windfall in public or in private. We collected baseline and four rounds of follow-up survey data after each round of the experiment, which allows us to examine the effect of the lottery windfalls on actual private and household expenditure.

We extend our understanding of intra-household allocation by testing the effect of asymmetric information on efficiency using actual spousal expenditure. The literature on asymmetric information on intra-household bargaining has focused on testing for efficiency within the experiment, instead of looking at the effect of information on outcomes outside of the laboratory (Ashraf, 2009; Schaner, 2015; Hoel, 2012; Kebede et al. 2013; Munro et al. (2008a; 2008b); Munro et al. 2011; Castilla, 2015; Cochard et al. 2009; Iversen et al., 2010). As part of the design, individual spouses completed an extensive household survey every 2 months after each lottery between March and October 2009. Conducting the survey every 2 months alleviates concerns over recall bias, since the

expenditures are relatively recent, and allows us to infer what winners did with the lottery prizes. In the survey spouses reported their individual expenditure in several items/categories, and were asked about what the lottery windfalls were used for. We estimate the causal effect of winning a public versus a private cash windfall on individual and household expenditure. The estimations provide inferential evidence of how the prizes were spent which we can contrast with the self-reports by each individual spouse.

Eastern Ghana is an ideal setting for analyzing intra-household resource allocation because of the extent to which the marital contract seems to deviate from the standard unitary model. In the tradition of the local Akan, men and women maintain separate economies, such that no spouse has control over all of the household's resources, and spending patterns differ by gender (Goldstein, 2004). Nonetheless, it is common for spouses to exchange resources formally through intra-household transfers called 'chop money' (usually flowing from husband to wife). Chop money is not a gift, but the husband's contribution towards food and household public goods purchased by the wife (Ogbu, 1978).

We first examine whether married couples allocate resources efficiently by testing for unitary and collective rationality in spousal expenditure. We use two different approaches which rely on different assumptions about the effect the prizes have on the distribution of bargaining power between spouses. In the first approach we use the Bourguignon et al. (2009) test for collective rationality which assumes that, conditional on total household income, windfalls received by one spouse affect expenditure through the sharing rule only, and in the second approach we test for full insurance which assumes the prizes have no effect on bargaining power. We find that intra-household allocation is not consistent with either unitary, collective rationality, or full insurance. Interestingly, results suggest that asymmetric information is not the cause of the inefficiency in spousal expenditure. Husbands' public cash prizes do not influence their wives' private

expenditure, and wives' public cash prizes do not influence their husbands' private expenditure, which we would expect to observe in cooperative households.

Private cash windfalls are spent differently by gender of the recipient. Husbands' who win cash prizes in private increase the probability of making gifts to other households. Wives also allocate private prizes towards gifts to other households, though they also increase their private expenditure in clothes, personal items, and contribute towards their husbands' public transportation expenses and home goods. We also found evidence that wives' private cash prizes increase expenditure in children in future rounds. This evidence is consistent with wives committing the prize money in the form of gifts in order to exercise discretion over how to spend it. Therefore, even though intra-household allocation is not Pareto efficient, asymmetric information over windfalls allows spouses to make investments in social capital through gifts, and to maintain discretion over how the money is spent.

II. Experimental Design and Survey

A. Sampling:

The field experiments were conducted between March and October 2009 in conjunction with a year-long household survey in four communities in Akwapim South district of Ghana's Eastern Region. This district lies 40 miles north of the nation's capital, Accra. Further details on the survey are provided in Walker (2011). The sample consists of approximately 70 monogamous and polygamous households from each of the four communities.[3] Slightly more than half of these

[3] We only include monogamous households in the empirical analysis as bargaining in polygamous households is different. This amounts to dropping 16 out of the 280 total households. In the

70 households were part of the initial 1997-98 sample (Goldstein & Udry, 1999), and the rest were recruited in January 2009 using stratified random sampling.[4] In the original sample, and in the 2009 re-sampling, households were selected only if headed by a resident married couple.[5] In some households from the 1997-98 sample, only one of the spouses remained. These 'single-headed households' account for between 7 and 12 households in each community. The sample of individuals included in the experiment was around 150 individuals in each of the four communities (Appendix A Table A.1).

Each respondent was interviewed five times during 2009, once every two months between February and November. Each survey round took approximately three weeks to complete, with the two survey teams each alternating between two villages. The survey covered a wide range of subjects including personal income, farming and non-farm business activities, gifts, transfers and loans, and household consumption expenditures. Each round, both the husband and wife in each household were interviewed separately on all of these topics. The expenditure module obtained detailed information on the quantities and values purchased of a variety of items. Referring to the month prior to the interview, each spouse was asked about his or her own expenditures, those of their partner, and about expenditures for the household as a whole. In the gifts and transfers module, respondents were asked to report any gifts (cash or kind) given and received during the past two months, obtaining information on the counterparty's location and relationship to the respondent, and the nature and value of the gift.

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robustness checks however, we include them in the analysis to find there are no significant differences in our results.

[4] New sample members were selected randomly from the subset of households in the community headed by a married couple. The sample was stratified by age of the head into three categories: 18-29, 30-64 and 65+, so that the shares of households whose head was in each of these categories corresponded to the community's shares.

[5] Some men in the sample have two or three wives, all of whom were excluded from the main analysis.

B. Experimental Design:

A field experiment was conducted during the panel survey fieldwork, to simulate unanticipated cash and in-kind windfalls. Every two months, a lottery was held in each community and 20 prizes of varying values were awarded randomly. Over the four lottery rounds, a total of 320 prizes were distributed in the four communities. The intervention was a two-by-two design: in each round, ten cash prizes and ten livestock prizes (chickens and goats) were awarded to every community. Half of these prizes (five cash, five livestock) were awarded at a public lottery, the other half in a private lucky-dip. The private lucky dips were conducted in a closed room, and the cash prizes given immediately so that the winner's identity was unknown even to their spouse.[6] Over the four lotteries, approximately 42 per cent of individuals and 62 per cent of households won at least one prize. The values of the cash prizes were GH¢10, GH¢20, GH¢35, GH¢50 and GH¢70, some of which are of substantial size relative to the mean monthly per capita expenditure of GH¢65.[7] In our sample, 78 husbands and 79 wives won cash prizes. There was a follow up survey conducted to figure out what winners did with their prizes. More than 50% of both winning husbands and wives reported using the prizes for consumption, and from the remainder households about one fourth invested the prizes in their businesses.

The livestock prizes were purchased by the survey team in Accra on the morning of the lottery and transported to the community. The chickens were of a type intended for eating, and were chosen because their price was essentially stable at GH¢10 throughout the year. The goats were bought individually by the team directly from traders at the main market near Accra. On the first visit, the

[6] The winner of course had the choice to disclose private windfalls to family or community members; what is important is that this design provided them the *opportunity* to conceal them.
[7] One Ghana cedi (GH¢) was worth about 70 US cents in mid 2009.

size and quality of goats available was established for the three price points (GH¢35, GH¢50 and GH¢70). On every subsequent visit, the team endeavored to obtain goats of similar size and quality, subject to market price and supply fluctuations.[8] Female goats were preferred because of their utility for breeding. The follow up survey revealed that 28 out of 180 of the livestock prizes were sold. The majority of winners kept the goats and ate the chickens.

The first round of the survey was designed as a baseline, therefore no lottery took place in that round. One week before each subsequent round, the lotteries and lucky dips took place. A village meeting was held in the community, and all respondents were invited to attend. Small amounts of food and drink were provided to encourage attendance. Generally around 100 people came to each meeting; roughly half of the respondents were present for the actual lottery draw.[9] There were usually a number of non-respondents at these meetings as well, including many children. At each gathering, the respondents were thanked for their continued participation in the survey. The team explained that respondents had a chance to win one of 20 prizes that day, framing the prizes as a gratuity for their participation in the survey.[10] Great care was taken to make clear to participants that the allocation of prizes was random, and that each respondent had an equal chance of winning in each round. Winners for the ten public prizes were then drawn (without replacement) from a bucket containing the names of the survey respondents. A village member not in the sample was chosen by the

[8] There was little price movement in the goat market throughout the year, though the price of chickens slowly appreciated, rising perhaps 20 per cent over 2009. The additional cost of the broiler chickens was absorbed to maintain consistency of the prizes across rounds. The quality of goats varied slightly between rounds in line with supply and climatic conditions, but a concerted effort was made to keep the quality and size of the animals close to constant within rounds.

[9] Around 125 of the 150 respondents in each community appeared for the private lucky dip, some of them arriving before or after the public meeting.

[10] At the start of the survey, respondents signed an informed consent form that explained how they would be remunerated for their participation in the survey. In addition to having the chance to win a prize, every respondent was given a small amount of cash after each survey round, at least one week before the lotteries.

villagers to do the draw, so as to emphasize that the outcomes were random. Each winner was announced, and asked to come forward to receive their prize. The prizes were announced and displayed before being awarded. Respondents who were absent at the time of drawing were called to pick up their prize in person. Spouses or close family members were allowed to receive the public livestock prizes (but not cash prizes) on the winner's behalf. Unclaimed prizes were delivered in person to the winner after the lottery.[11]

The lucky dip took place immediately after the lottery. Respondents were asked to identify themselves to an enumerator, who took their thumbprint or signature and issued them with a ticket displaying their name and identification number. The respondents then waited to enter a closed school room, one at a time, where another enumerator invited them to draw a bottle cap without replacement from a bag.[12] There was one bottle cap for each of the *n* respondents in the community. Of these, *n*-10 were non-winning tokens (red colored), and 10 were winning tokens, marked distinctively to indicate one of the ten prizes.[13] Those who drew winning tokens were informed immediately that they had won a prize, and were told that they did not have to tell anyone else that they had won. The survey team made clear that they would not divulge the identities of the lucky dip prize winners. Cash prizes were given to the winners immediately. Livestock prizes were delivered one or two days later to the winner in person, or to another household member if they were absent.[14,15]

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[11] We have data on these cases, including the dates on which the prizes were claimed and the identity of the recipient (if not the winner).

[12] Care was taken to shuffle the bottle caps after each draw, and to prevent respondents from seeing into the bag. If a respondent inadvertently drew more than one bottle cap, those caps were shuffled and the respondent was asked to blindly select one of them.

[13] Respondents were shown a sheet relating the tokens to the prizes; this sheet was used to explain what prize (if any) the respondent had won based on the token they drew.

[14] If anyone received the prize on behalf of the winner, the survey team made clear who the animal was intended for. In the follow-up survey, each winner was interviewed privately about their prize, and established that all of them ultimately received their prizes. At the conclusion of the day, tokens which had not been drawn were counted and the remaining prizes allocated randomly

C. Descriptive Statistics

The interviews commenced one week after the lottery to allow winners to receive their prize and do something with it. The interviews took place in no specified order throughout the following three weeks. The sample is composed of agricultural households where men own at least one plot on average, while women own half a plot. Men's plots are four times as large as women plots, though women plots are located closer to the home. Households have about 5 members, where spouses have 1.7 children on average. Over 90% of spouses live together on the same house. Men have on average 2 more years of schooling than their wives and husbands also score higher on the math ability test.

Total household expenditure amounts to over GH¢ 470, which at the time was equivalent to 7.2 dollars over a two month period. Of total household expenditure, about half goes towards purchasing food, one fifth towards household goods such as children expenses, home items, and utilities. Husbands make chop money transfers to wives of about GH¢ 19 per week or so to run the house. Spousal transfers in the form of gifts or money for their businesses amounts to more than twice as much as the chop money, and these occur in 92% of households. The panel on the right contains the breakdown of expenditures by each individual spouse. It is clear that wives pay for most of the food expenses (which would be expected) and husbands pay for two thirds of household goods. Both spouses report similar amounts of private expenditure and gifts.

Table 1 presents a summary of the balance of treatment statistics at baseline. There are no differences on average household expenditure on any

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among the non-attending respondents using a computer. There were usually 25-30 non-attendees and less than three prizes remaining.

[15] Clearly there was no way of keeping the livestock prizes completely secret. It should be assumed that members of the winner's household were all aware of those prizes. However, the delivery of the lucky dip livestock prizes was kept as low-key as possible. Thus there is a strong difference in publicity between the lottery and lucky dip prizes, at least with respect to non-household members.

category between households where at least one individual won a prize relative to households did not win any prize except for expenditure in utilities at the 10% significance level. Likewise, private expenditure of each spouse in personal items, clothing, ceremonies, inter-household (gifts and loans) and intra-household transfers (chop money) was not statistically different across prize winners relative no non-winners. Husbands' total expenditure is larger in the control group at the 10% significance level, and that is driven by differences in food purchases.

Table 1. Balance of treatment: variables at baseline (Round 1) by lottery outcome

Household Level Variables	Household: Using Wives Reports		Individual Level Variables	Individual: Wife		Individual: Husband	
	Prize (Average)	No Prize (Difference)		Prize (Average)	No Prize (Difference)	Prize (Average)	No Prize (Difference)
No. HH Members	5.014	-0.065	Total Individual Expenditure	187.790	5.978	159.745	43.387*
	[0.169]	[0.243]		[17.128]	[24.611]	[15.580]	[22.321]
No. Children	1.724	0.239	Exp. Private Goods	24.906	-1.116	28.158	4.605
	[0.118]	[0.170]		[2.723]	[3.912]	[4.999]	[7.163]
Ln (Illiquid Assets)	6.662	-0.092	Exp. Personal Care & Clothing	11.883	0.384	9.077	0.099
	[0.085]	[0.122]		[0.921]	[1.324]	[1.408]	[2.018]
Ln (Liquid Assets)	5.437	-0.172	Exp. Public Transportation	6.922	1.844	10.734	-1.669
	[0.127]	[0.182]		[1.358]	[1.951]	[1.365]	[1.956]
Total HH Expenditure	478.275	3.941	Exp. Food	119.485	8.045	28.292	19.482*
	[24.598]	[35.346]		[14.674]	[21.085]	[7.955]	[11.397]
Exp. Food	241.159	-7.487	Exp. Household Goods	30.584	-0.070	60.894	15.615
	[16.551]	[23.712]		[5.171]	[7.430]	[8.124]	[11.640]
Exp. Household Goods	93.009	10.199	Exp. Ceremonies	3.493	0.251	7.300	5.538
	[10.369]	[14.856]		[0.787]	[1.130]	[2.461]	[3.526]
Exp. Children	43.238	5.299	% Households with Exp. Ceremonies>0	0.635	-0.009	0.650	-0.041
	[7.376]	[10.568]		[0.040]	[0.057]	[0.041]	[0.059]
Exp. Home Items	16.254	2.922	Amount Gifts	14.279	-7.670	18.822	1.220
	[3.197]	[4.580]		[6.115]	[8.752]	[4.288]	[6.097]
Exp_Utilities	14.570	5.208*	% Households with Gifts>0	0.430	-0.007	0.560	0.019
	[1.909]	[2.735]		[0.040]	[0.058]	[0.042]	[0.059]
Exp. Ceremonies	11.107	4.039	Score Math Test	4.587	0.053	6.061	-0.004
	[2.635]	[3.775]		[0.244]	[0.354]	[0.210]	[0.302]
% Households with Exp. Ceremonies>0	0.650	-0.041	Years of Schooling	6.352	-0.165	8.902	-0.113
	[0.041]	[0.059]		[0.314]	[0.457]	[0.324]	[0.466]
Chop Money	19.005	-1.932	% HH were Spouse lives in same house	0.911	-0.007	0.933	-0.008
	[1.037]	[1.475]		[0.025]	[0.037]	[0.022]	[0.033]
Spousal Transfers	52.818	0.581	% HH where Spouses Get Along (=1 if Well or Very Well)	0.702	-0.098*	0.823	-0.076
	[3.543]	[5.088]		[0.039]	[0.055]	[0.035]	[0.049]
% Households with Sp. Transfers>0	0.926	0.027	% HH Trust Spouse (=1 if Mostly or Completely)	0.715	-0.042	0.865	-0.083*
	[0.021]	[0.029]		[0.038]	[0.054]	[0.032]	[0.045]
-	-	-	Number of plots	0.563	-0.063	1.631	-0.064
				[0.066]	[0.095]	[0.091]	[0.130]
-	-	-	Total area of land (hectares)	1,748.788	-229.760	8,617.312	-1670.111
				[269.981]	[389.238]	[792.862]	[1135.825]

Note: Tests were conducted using OLS regressions. For the Prize winning groups we present averages, and for the control group the difference relative to the mean. Stan
Expenditure in thousands of Cedis. *** p-value<0.01, ** p-value<0.05, * p-value<0.10

Testing for Cooperation in Ghanaian Households

In Ghanaian households, it is not the norm for men and women to pool resources (Chao, 1998; Clark, 1999). Husbands and wives maintain separate financial arrangements for spending, saving, and asset ownership. As a result of the Akan matrilineal inheritance system, husbands and wives rarely own, manage or inherit property together.[16] Oppong (1974) found that husbands were twice as likely to own property with their kin as with their wives, and only ten percent of households had joint accounts. Although these observations are dated, our 2009 survey data confirm that asset ownership and inheritance patterns remain distinctly separate between spouses. Similar to the observations of Duflo and Udry (2003) from Cote d'Ivoire, men and women tend to have separate income streams, and there is often a traditional gender-based division of responsibilities for different types of expenditure (Chao, 1998). Women bear primary responsibility for childrearing, cooking, washing and collecting fuel, wood and water. Men make contributions of produce from their farms and cash transfers called 'chop money', out of which their wives purchase the household's food and other public goods and services (Chao, 1998; Udry and Goldstein, 1999).

Nonetheless, men and women maintaining separate financial arrangements does not necessarily prevent cooperation and allocative efficiency via intra-household transfers. Further, in cooperative households spouses share information, thus the observability of the prizes should have no differential effect on allocations. For this reason, we first test formally whether intra-household allocation of the lottery prizes is Pareto efficient. We use two different approaches which rely on different assumptions about the effect the prizes have on the distribution of bargaining power between spouses. In the first approach we use the

[16] Most of the respondents were of Akan heritage, although a small number are immigrants with a different clan heritage (e.g. the patrilineal Ewe).

Bourguignon et al. (2009) test for collective rationality which assumes that, conditional on total household income, windfalls received by one spouse affect expenditure through the sharing rule only, and in the second approach we test for full insurance which assumes the prizes have no effect on bargaining power.

Theoretical Framework:

In a cooperative household, individuals are able to negotiate binding agreements with zero transaction costs, yielding Pareto Efficient allocations. Assume each spouse has preferences over money for private consumption $(x_i\ )$, and money for shared (household) consumption (x_q), thus $u_i(x_q, x_i)$. Without loss of generality (and following Browning and Chiappori (1998)), the household welfare function, W, is then a weighted sum of individual sub-utilities where μ is the weight of each individual. The household chooses allocations to maximize W subject to the household budget constraint in which all sources of income are pooled:

$$\begin{aligned} max_{q,x_f,x_m}\ & W = \ \mu\, u_f(x_q, x_f) + (1-\mu)\, u_m(x_q, x_m) \\ \textit{Subject to}:\ & x_q + x_f + x_m \leq Y_f + Y_m + I_f + I_m \\ & \mu = \mu(Y_f, Y_m, I_f, I_m, z) \end{aligned} \tag{1}$$

Where Y_i is the total income of individual $i \in [f, m]$, and z is a vector of partner-specific distribution factors, such as resources originally brought into the marriage, the share of the available resources controlled by each spouse, etc. The variables I_f and I_m are the experimental lottery windfalls, such that $I_i = 0$ if the individual does not win, and $I_i > 0$ if he or she does win. In equilibrium, the demand for each good is a function of total household income, partner-specific lottery windfalls, and the pareto weight: $x_q(Y_f + Y_m + I_f + I_m, \mu)$, $x^m(Y_f + Y_m + I_f + I_m, \mu)$, $x^f\,(Y_f + Y_m + I_f + I_m, \mu)$.

In the experiment the lottery windfalls were transitory, thus one concern may be that households smooth consumption and therefore the prizes would have no effect on expenditure. However, in rural Ghana access to formal credit and

savings is uncommon making it unlikely that households smooth consumption across rounds. Because the windfalls were transitory, we would expect they should not have an effect on bargaining power. However, the prizes were quite large ranging from one sixth of monthly per capita expenditure (cash prizes equal to GH¢10 or chickens of the same value) to GH¢70. The larger prizes had the potential to influence bargaining power as they were enough to invest in assets such as a goat for instance. It is unclear whether the lottery windfalls influenced the distribution of bargaining power between spouses in favor of the winner. For this reason, we use two different tests for intra-household allocative efficiency.

A. Tests for Unitary and Collective Rationality if Windfalls affect Bargaining Power

Bourguignon et al. (2009) show the conditions that the demand functions and Engel curves must satisfy in order for household allocation to be Pareto Efficient, and to distinguish between allocations that are consistent with unitary and/or collective rationality. Under the unitary household model (Samuelson 1956; Becker 1991) income pooling occurs in equilibrium, and the distribution of resources within the household should not influence intra-household allocations. The test for the unitary model consists of estimating the system of demand equations and, conditional on total household income, distribution factors such as the lottery prizes should not influence demand.

$$\left.\frac{\theta_g^i}{\partial z}\right|_Y = 0 \quad \forall i, g \tag{2}$$

Where θ_g^i is the budget share of expenditure in good g, i the individual spouse, z is vector of distribution factors, and total household income is $Y = Y_f + Y_m + I_f + I_m$.

Under the collective model both the total family resources and the distribution of resources between household members influence allocations, while still restricting these to be Pareto efficient. The Pareto weight, $\mu = \mu(Y_f, Y_m, I_f, I_m, z)$,

influences the sharing rule, which in turn determines the distribution of resources between household members. The distribution factors (z) affect allocations through their impact on the decision process (sharing rule) in addition to the influence through the aggregate resource constraint (Bobonis, 2009; Browning and Chiappori, 1998). The sharing rule depends on the distribution of bargaining power between spouses, thus, conditional on total income, the distribution factors only influence allocations through changes in bargaining power. Bourguignon et al. (2009) show that a necessary and sufficient condition to identify collective rationality is given by the proportionality of the ratio of partial derivatives of the demand for each good with respect to two different distribution factors, and establish that the ratios across all goods must equal to the ratio of distribution factor effects on the Pareto weight:

$$\frac{\frac{\partial\theta_g^i}{\partial z_1}}{\frac{\partial\theta_g^i}{\partial z_2}} = \frac{\frac{\partial\theta_g^j}{\partial z_1}}{\frac{\partial\theta_g^j}{\partial z_2}} = \frac{\frac{\partial\theta_k^i}{\partial z_1}}{\frac{\partial\theta_k^i}{\partial z_2}} = \frac{\frac{\partial\theta_k^j}{\partial z_1}}{\frac{\partial\theta_k^j}{\partial z_2}} = \frac{\frac{\partial\mu}{\partial z_1}}{\frac{\partial\mu}{\partial z_2}} \qquad \forall i \neq j, g \neq k \tag{3}$$

The proportionality condition is intuitive: the ratio of marginal propensities to consume any specific good in response to changes in different distribution factors should equal the ratio of the effect they have on the Pareto weight (or bargaining power). This condition holds if and only if distribution factors affect demand exclusively through the Pareto weight.

There is an alternative (and more powerful) test of collective rationality termed the z-conditional demand system approach (Bourguignon et al. 2009). Under the additional assumption that the demand for one of the goods is strictly monotone in one distribution factor, the demand for that good can be inverted on the factor. Assume that θ_k^i is strictly monotone in z_1, then:

$$[\theta_k\,]^{-1} = z_1 = f(Y_f + Y_m + I_f + I_m, \theta_k\,) \tag{4}$$

substituting (4) into the rest of the demand functions yields the z-conditional system of demand:

$$\bar{\theta}_g^{\theta_k} = f\left(Y_f + Y_m + I_f + I_m, \theta_k \,|z_1\right) \quad \forall g \neq k \tag{5}$$

The proportionality condition is equivalent to the condition that $\frac{\partial \bar{\theta}_g^{\theta_k}}{\partial z_2} = 0$ for at least one good $g \neq k$. The intuition behind this test implies that the information contained in the quantity demanded of the invertible good (θ_k in this case) is enough to identify the location of the new equilibrium on the efficiency frontier in response to changes in z_1.

Estimating the system of demand functions that result from the optimization problem in (1) and testing conditions (2), (3) and (5) requires data on budget shares allocated towards public and private goods, as well as two different distribution factors. In the survey, expenditure was reported by each spouse individually and privately, to an enumerator of the same gender. We will use expenditure instead of consumption to measure demand. While it is possible that some of the expenditure in different categories may have been for someone other than the respondent, in the survey transfers, loans, and gifts, both between spouses and to/from other households were recorded separately. Therefore, we can plausibly assume the reported expenditure reflects consumption on the relevant category. For household public goods we look at expenditure for the home (rent, equipment, and household items), in food, children, and utilities (fuel wood, water, etc). As private or assignable we consider expenditure in adult clothing and personal care, as well as public transportation.

To obtain consistent estimates of the partial effects of each distribution factor on the demand for all goods further imposes the restriction of exogenous variation in the distribution factors and total household income. The experimental design provides two such distribution factors: the cash lottery windfalls received by each individual spouse. The cash lottery prize won by an individual spouse in a particular round was random and community members who participated in the survey had an

equal probability of winning in each round, guaranteeing uncorrelatedness with unobserved individual and/or household heterogeneity.

In the experiment, half of the prizes were given in public and the remaining half in private. If intra-household allocation is cooperative, spouses share information, and there should be no differences in the treatment effect of public and private cash prizes on expenditure. If the cash windfalls affect bargaining power, then regardless of whether they were received in public or private, we should observe an increase in expenditure on items preferred by the recipient. In order to increase bargaining power, private prizes would have to be revealed to the uninformed spouse, thus the publicity of the windfalls would not differentially affect allocations in a cooperative household. Finally, 126 husbands and 124 wives (out of the 128 couples who won at least one prize) report to have told their spouse about winning a prize.

The parametric reduced-form Engel curve for each good g is given by equation (6):

$$f\left(\theta_{g,h,r}^{i}\right) = \beta_{1,g} I_{h,r}^{m} + \beta_{2,g} I_{h,r}^{f} + \beta_{3,g} L_{h,r} + \beta_{4,g} Y_{h,r} + \sum_{r=1}^{5} \sigma_r + \sum_{h=1}^{n} \tau_r + \varepsilon_{g,h,r}^{i} \qquad (6)$$

Where $f\left(\theta_{g,h,r}^{i}\right) = ln\left[\theta_{g,h,r}^{i} + \sqrt[2]{\left(\theta_{g,h,r}^{i}\right)^{2} + 1}\right]$ and $\theta_{g,h,r}^{i}$ is the budget share allocated towards good g for household h in round r; $I_{h,r}^{m}$ and $I_{h,r}^{f}$ are the cash prizes won by the husband and the wife respectively; $L_{h,r}$ is the sum of all household livestock prizes; $Y_{h,r}$ is total household expenditure in round r; $\sum_{r=1}^{5} \sigma_r$ are round fixed-effects. The income data proved too noisy to use, thus we use total household expenditure instead. To further control for unobserved heterogeneity, household fixed-effects $\sum_{i=1}^{n} \tau_h$ are also included in the estimation. For the main results we estimate the system of demand shares using a log-linear specification in which we

use the Inverse Hyperbolic Sine Transformation (instead of natural log)[17] due to the possibility of zero demand in any specific round.

Table 2: Proportionality Tests of Unitary and Collective Rationality

	Log - Linear				AIDS			
	Husband Cash	Wife Cash	Tot. Exp	Controls	Ln (Husband Cash)	Ln (Wife Cash)	ln (Tot. Exp)	Controls
Food	-0.001	-0.001	-0.000**	Yes	-0.452	-0.699	-7.640***	Yes
	[0.001]	[0.001]	[0.000]		[0.345]	[0.361]	[2.046]	
Children	0.001	0.001	0.002***	Yes	-0.059	0.178	7.986***	Yes
	[0.003]	[0.004]	[0.000]		[0.232]	[0.320]	[1.474]	
Utilities	0.004**	0.000	-0.001***	Yes	0.220**	0.054	-2.412***	Yes
	[0.002]	[0.002]	[0.000]		[0.100]	[0.082]	[0.320]	
Home	-0.002	0.007**	0.001**	Yes	-0.102	0.331**	1.007**	Yes
	[0.003]	[0.003]	[0.000]		[0.124]	[0.152]	[0.420]	
Wife's Personal	0.002	0.001	-0.001***	Yes	0.042	0.048	-1.512***	Yes
	[0.002]	[0.001]	[0.000]		[0.076]	[0.066]	[0.284]	
Wife's Public Transportaion	-0.002	0.002	-0.000**	Yes	-0.063	0.088	0.081	Yes
	[0.003]	[0.002]	[0.000]		[0.059]	[0.081]	[0.746]	
Husband's Personal	0.005*	0.002	0.000	Yes	0.246	0.041	-0.24	Yes
	[0.003]	[0.002]	[0.000]		[0.130]	[0.047]	[0.205]	
Husband's Public Transportation	0.001	0.003	0.000	Yes	-0.092	0.037	-0.773*	Yes
	[0.002]	[0.002]	[0.000]		[0.069]	[0.087]	[0.382]	
Unitary Rationality	$\chi2$ (16) =	27.63***			$\chi2$ (16) =	29.89***		
Collective Rationality	$\chi2$ (16) =	3.49			$\chi2$ (16) =	3.87		
Weak Instruments	$\chi2$ (16) =	5.78**			$\chi2$ (16) =	4.72**		
N = 992								

Note: Regressions estimated as a system by GMM. Clustered standard errors at the household level in brackets.
Control variables include liquid and illiquid assets, livestock prizes, round fixed effects, and household fixed effects.
The natural log of the share of the endowment and cash prizes is aproximated using the Inverse Hyperbolic Sine Transformation due to zero
*** p-value<0.01, ** p-value<0.05, * p-value<0.10

The test for unitary rationality consists of $\beta_{1,g} = \beta_{2,g} = 0$ in all 6 equations and is derived from equation (2) implying that conditional on the total household endowment, the distribution of money between spouses should not influence allocation decisions. Table 2 contains results of estimating the system of Engel curves implied by equation (6) including both round and household fixed effects. We present results for two different functional forms (log-linear) and the Almost Ideal Demand System (AIDS) and find consistent results. The first result to note

[17] McKinnon and Magee (1990) show that the Inverse Hyperbolic Sine Transformation can be applied to variables that equal zero without significantly transforming the variable $f\left(\theta^{i}_{g,h,r}\right) = ln\left[\theta^{i}_{g,h,r} + \sqrt[2]{\left(\theta^{i}_{g,h,r}\right)^{2} + 1}\right]$.

is that cash windfalls of the husband are spent differently than cash windfalls of the wife. Husbands use their earnings to pay for utilities and to purchase clothes and personal items, while wives allocate their prizes towards home expenses The effect of the cash prizes on these expenses is statistically significant, though small in magnitude.

The z-conditional demand version of the test for collective rationality consists of two parts estimated simultaneously. The first step requires estimating equation (6) for the budget share of the good that is invertible in at least one distribution factor. There is an additional restriction that is needed to implement this version of the proportionality test. The budget share of the invertible good must be strictly monotonic in one distribution factor and this factor must be uncorrelated with individual or household heterogeneity. For this test, I use the cash prize won by the wife as an instrument that monotonically increases expenditure on home goods, and is uncorrelated with individual or household heterogeneity. On the second step, the system of the remaining demand equations is estimated as a function of the budget share allocated towards home goods, the cash lottery prize won by the husband, and total household expenditure. As explained in the earlier section, the intuition of the test rests on the notion that the demand for the omitted good (expenditure on home goods) contains enough information such that conditional on total household resources, cash prizes won by the husband should not affect allocations. The z-conditional Engel curve for each good g is given by equation (7):

$$f(\theta^{i}_{g,h,r}) = \alpha_{1,g}\hat{\theta}_{1,h,r} + \alpha_{2,g}I^{m}_{h,r} + \alpha_{3,g}L_{h,r} + \alpha_{4,g}Y_{h,r} + \sum_{r=1}^{7}\sigma_r + \sum_{h=1}^{n}\tau_h + \varepsilon_{g,h,r} \quad (7)$$

where $\hat{\theta}_{1,h,r}$ is the budget share allocated towards home goods in household h in round r. The z-conditional demand test implies intra-household allocation is consistent with collective rationality if $\alpha_{2,g} = 0\ \forall g \neq 1$. In this test we are not differentiating between public and private cash (or livestock) prizes won by each

individual spouse because there should be no differences in allocations between prizes won in public or in private when intra-household bargaining is cooperative. Table 6 reports the results of estimating the system of Engel curves implied by equation (7). The results on the first stage were presented in Table 2. It is clear that cash windfalls of the wife are a strong predictor of the share allocated towards home goods; it is a strong instrument with significance at the 5% level.

Table 3: z-Conditional Demand Test of Collective Rationality

	Log- Linear				AIDS			
		Home Exp.	Tot. Exp	Controls	ln (Husband Cash)	Home Exp.	Ln (Tot. Exp)	Controls
Food	-0.001	-0.169*	0.000	Yes	-0.72	-2.579**	-5.006**	Yes
	[0.001]	[0.097]	[0.000]		[0.449]	[1.258]	[2.502]	
Children	0.003	0.600	0.001**	Yes	0.038	0.902	7.050***	Yes
	[0.004]	[0.521]	[0.000]		[0.307]	[0.997]	[1.685]	
Utilities	0.004**	-0.112	-0.001***	Yes	0.229**	0.099	-2.506***	Yes
	[0.002]	[0.191]	[0.000]		[0.103]	[0.228]	[0.438]	
Wife's Personal	0.003	0.266	-0.001***	Yes	0.062	0.187	-1.703***	Yes
	[0.003]	[0.195]	[0.000]		[0.085]	[0.181]	[0.343]	
Wife's Public Transportaion	-0.002	0.274	-0.001**	Yes	-0.033	0.293	-0.216	Yes
	[0.003]	[0.280]	[0.000]		[0.080]	[0.259]	[0.887]	
Husband's Personal	0.005*	0.161	0.000	Yes	0.26	0.141	-0.384	Yes
	[0.003]	[0.216]	[0.000]		[0.133]	[0.152]	[0.278]	
Husband's Public Transportation	0.001	0.213	0.000	Yes	-0.087	0.06	-0.829**	Yes
	[0.002]	[0.272]	[0.000]		[0.069]	[0.235]	[0.371]	
Collective Rationality	$\chi2$ (7) =	13.41 (0.067)			$\chi2$ (7) =	19.97 (0.006)		
N = 992								

Note: Regressions estimated as a system by GMM. Clustered standard errors at the household level in brackets.
Control variables include liquid and illiquid assets, livestock prizes, round fixed effects, and household fixed effects.
The log of the share of the endowment is aproximated using the Inverse Hyperbolic Sine Transformation due to zeros.
*** p-value<0.01, ** p-value<0.05, * p-value<0.10

Table 3 contains the results which show that cash windfalls won by husbands continue to have a positive and significant effect both on utilities and personal expenses even after conditioning on the budget share on home goods, suggesting that intra-household allocation is non-cooperative. Using the z-conditional demand test we can reject collective rationality at the 93% confidence level using a log-linear specification, and at the 99% confidence level using the AIDS specification. However, it is not clear from the results in Table 2 whether

the cash windfalls had a significant influence on the distribution of bargaining power in favor of the winning spouse. When husbands win, they increase their personal expenditure, but wives only adjust their expenditure on home goods. It is likely that wives have a preference for home goods, but a shift in bargaining power would increase expenditure in all allocations preferred by the corresponding spouse. For this reason, in the next section we test whether intra-household allocation is cooperative under the assumption that the lottery windfalls did not affect the distribution of bargaining power.

B. Testing Efficiency if Lottery Windfalls do not affect Bargaining Power

Following Robinson (2012), the key assumption of the first test is that receiving the lottery windfalls has no influence on the distribution of bargaining power, $\frac{\partial \mu}{\partial I_f} = \frac{\partial \mu}{\partial I_m} = 0$. If this is the case, the lottery windfalls should have the same effect on expenditure regardless of the gender of the recipient. To implement the empirical test, we assume that assignable private and shared consumption (household public goods) are additively separable and focus primarily on private consumption because it is assignable, while it is difficult to determine who benefits from different household public goods (Robinson, 2012). The test is intuitive in the sense that under income pooling, any additional income whether it is received by the husband or the wife should have no differential effect on own versus spousal assignable expenditure. Formally, this implies that $\mu \frac{\partial u_f}{\partial I_f} = (1-\mu)\frac{\partial u_f}{\partial I_m}$, which simplifies to $\frac{\partial x^i}{\partial I_f} = \frac{\partial x^i}{\partial I_m}$ under standard utility assumptions. The empirical specification for this test can be expressed as follows:

$$f\left(x^i_{g,h,r}\right) = \beta_1 I^m_{h,r} + \beta_2 I^f_{h,r} + \beta_3 L^m_{h,r} + \beta_4 L^f_{h,r} + \sum_{r=1}^{5} \sigma_r + \sum_{h=1}^{n} \tau_h + \varepsilon^i_{g,h,r} \qquad (8)$$

Where $f(x^i_{g,h,r}) = ln\left[x^i_{g,h,r} + \sqrt[2]{(x^i_{g,h,r})^2 + 1}\right]$, $x^i_{g,h,r}$ is the expenditure by spouse i in good g; $I^m_{h,r}$ and $L^m_{h,r}$ are the husband's cash and livestock prizes respectively; $I^f_{h,r}$ and $L^f_{h,r}$ are the wife's cash and livestock prizes respectively; i indicates the individual spouse, g indicates the type of good, h the household, and r the survey round; σ_r is a fixed effect for the round; and τ_h is a household (individual) fixed effect.

The test for Pareto efficiency is then $\beta_1 = \beta_2$ and $\beta_3 = \beta_4$. A stronger test would be for all 4 marginal propensities to consume to be equal, however, it is possible that individuals treat cash prizes differently that in-kind (livestock) prizes due to liquidity constraints. As before, we do not differentiate between cash or livestock prizes won in public or in private by an individual spouse in any of the efficiency tests. However, in this test we do not pool livestock prizes won by husbands and wives.

We estimate equation (8) separately for the husband and wife's private expenditure, though Table 4 also includes results for other expenditure categories. Private expenditure includes money spent on personal care, public transportation, adult clothing, alcohol, tobacco, soda, meals outside the home, and entertainment, reported by each individual spouse[18]. For this test we pool all private expenditures by an individual spouse together because we no longer need to examine whether the windfalls had an effect on all goods preferred by each spouse which allows inference on the effect of the prizes on bargaining power, but the results hold if we look at different categories of private expenditure. The other categories include individual expenditure on food, household goods (including children, home goods, health, and utilities), as well as intra and inter household transfers.

[18] Private expenditure includes jewelry for women but not for men.

The results indicate that husbands' cash lottery windfalls impact their own private expenditure but not their wives'. Likewise, wives' cash windfalls do not impact their husband's private expenditure. In Appendix Table A.2 we present results on the effects of prizes won in the current and the previous round, and find that wives' cash prizes impact their own private expenditure, but not their husbands'. There is limited evidence that husbands' cash prizes in the previous round increase wives' private expenditure, though the effect is small and only statistically significant at the 90% confidence level. These results provide further evidence that intra-household allocation is not cooperative. When a husband wins cash both his and her wife's expenditure on household goods increase, while when the wife wins only her own expenditure in household goods increases. Livestock prizes do not seem to have differential effects (or any effect) on spousal individual expenditure.

In this region of Ghana is common for the husband to give a housekeeping allowance (chop money) to his wife for food and other household expenses. It is possible that husbands' cash windfalls had no effect on wives' private expenditure because husbands shared their winnings explicitly via gifts or chop money transfers to their wives. The last two columns contain chop money transfers and net gifts between spouses. The gifts between spouses include cash or in-kind transfers from one spouse to the other. While there are very few households were chop money is equal to zero, the proportion of households with zero intra-household gifts is much larger. For this reason, we estimate a linear probability model on a dummy variable equal to 1 if spouse *s* gave a gift to his/her partner in round *r*, and zero otherwise.

Lottery windfalls had no effect on chop money or gifts between spouses, regardless of the gender of the recipient, indicating the cash prizes were not shared between spouses through gifts or transfers. This is consistent with individual survey responses where 95% of husbands reported giving the same

amount of chop money to their wives. So far the evidence is consistent against the cooperative household. It is possible that the loss in efficiency is caused by lack of sharing of information among spouses. Alternatively, it is also possible that spouses already were operating under a non-cooperative contract, and information was not the cause of allocative inefficiency.

Table 4: Lottery Windfalls and Individual Spousal Expenditure

	Husband's Ln (Expenditre in …)				Wife's Ln (Expenditre in …)				Net Intra-HH Transfers	
	Total	Private	Food	Household Goods	Total	Private	Food	Household Goods	Chop Money	Gifts to Spouse a/
Husband Cash Prize	0.008***	0.008**	0.004	0.009***	0.000	0.003	-0.002	0.009**	0.002	0.001
	[0.002]	[0.003]	[0.004]	[0.003]	[0.004]	[0.004]	[0.004]	[0.004]	[0.003]	[0.001]
Husband Livestock Prize	0.001	0.004	0.003	-0.001	0.004**	0.003	0.002	0.011***	-0.003	0.000
	[0.003]	[0.003]	[0.004]	[0.004]	[0.002]	[0.002]	[0.002]	[0.004]	[0.004]	[0.001]
Wife Cash Prize	-0.001	-0.002	0.005	-0.002	-0.000	-0.001	0.000	-0.003	-0.000	-0.001*
	[0.003]	[0.003]	[0.003]	[0.005]	[0.003]	[0.002]	[0.003]	[0.003]	[0.003]	[0.001]
Wife Livestock Prize	0.001	0.001	-0.005	-0.002	0.005**	0.002	0.005**	0.008*	0.007**	0.001**
	[0.004]	[0.004]	[0.005]	[0.005]	[0.002]	[0.002]	[0.002]	[0.004]	[0.003]	[0.001]
Round FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Individual FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1345	1345	1345	1345	1410	1410	1410	1410	1469	1382
R-squared	0.046	0.023	0.008	0.068	0.037	0.022	0.021	0.027	0.022	0.025

Note: Regressions estimated with individual and round fixed effects. Standard errors clustered at the individual level in brackets.
Ln (Expenditure) is computed using the Inverse Hyperbolic Sine Transformation.
a/ the dependent variable is dichotomous, equal to 1 if gifts to spouse>0, and 0 if gifts to spouse = 0
*** p-value<0.01, ** p-value<0.05, * p-value<0.10

In Table 5 we present results for equation (8) differentiating between public and private prizes won by each spouse. Husbands' windfalls influence their own private expenditure but have no effect on wives' private expenditure regardless of the publicity or liquidity of the prize. Husbands' public cash windfalls increase private expenditure and expenses in household public goods, while private cash prizes increase their own private expenditure only. Wives' public windfalls influence their expenditure on household goods, while private cash windfalls increase both expenditure on household goods and private expenses. Interestingly, wives' private cash prizes increase husbands' private expenditure as well. These results suggest that while windfalls differing on their degree of publicity are spent

differently, asymmetric information is not the cause of allocative inefficiency among these households. Public prizes won by husbands have no effect on wives' private expenditure, and wives' public prizes do not affect husbands' private expenditure either.

Table 5: Individual Spousal Expenditure and Windfalls by degree of Publicity

	Husband's Expenditures				Wife's Expenditures			
	Total	Private	Food	HH Goods	Total	Private	Food	HH Goods
Husband Cash Prize Public	0.012***	0.011*	0.002	0.016***	0.004	0.004	0.001	0.009
	[0.003]	[0.006]	[0.006]	[0.005]	[0.004]	[0.004]	[0.005]	[0.006]
Husband Cash Prize Private	0.006**	0.006*	0.006	0.004	-0.003	0.002	-0.004	0.009
	[0.003]	[0.004]	[0.005]	[0.004]	[0.007]	[0.006]	[0.007]	[0.006]
Husband Livestock Prize Public	-0.002	-0.003	0.003	-0.000	0.002	0.001	0.001	-0.003
	[0.003]	[0.003]	[0.003]	[0.005]	[0.004]	[0.004]	[0.004]	[0.004]
Husband Livestock Prize Private	-0.001	-0.001	0.007	-0.005	-0.003	-0.003	-0.001	-0.003
	[0.004]	[0.004]	[0.005]	[0.007]	[0.003]	[0.004]	[0.003]	[0.003]
Wife Cash Prize Public	-0.000	0.000	0.002	-0.003	0.003*	0.000	0.002	0.009**
	[0.004]	[0.003]	[0.006]	[0.006]	[0.002]	[0.002]	[0.002]	[0.005]
Wife Cash Prize Private	0.002	0.008***	0.004	0.003	0.005*	0.005*	0.003	0.014***
	[0.002]	[0.002]	[0.003]	[0.004]	[0.003]	[0.003]	[0.003]	[0.005]
Wife Livestock Prize Public	-0.007	-0.004	-0.011	-0.011	0.003	0.001	0.002	0.011*
	[0.005]	[0.004]	[0.007]	[0.007]	[0.002]	[0.002]	[0.002]	[0.006]
Wife Livestock Prize Private	0.009	0.005	-0.000	0.007	0.007**	0.003	0.007**	0.005
	[0.006]	[0.006]	[0.007]	[0.006]	[0.003]	[0.003]	[0.003]	[0.004]
N	1345	1345	1345	1345	1410	1410	1410	1410
R-squared	0.040	0.126	0.009	0.043	0.045	0.124	0.009	0.043

Note: Regressions estimated by linear probability fixed effects.
Standard errors clustered at the individual level in brackets.
Ln (Expenditure) is computed using the Inverse Hyperbolic Sine Transformation.
*** p-value<0.01, ** p-value<0.05, * p-value<0.10

III. Asymmetric Information and Non-Cooperative Behavior

In the previous section we showed that intra-household allocation is not consistent with unitary or collective rationality, and that each spouse's windfalls do not influence their partner's private expenditure. We also presented evidence

suggesting that the loss in efficiency does not seem to be caused by asymmetric information, as public cash prizes won by either spouse do not influence their partner's private expenditure. It is not clear, however, whether spouses took advantage of asymmetric information for personal benefit or whether the presence of asymmetric information allowed them to allocate the money in a way they prefer but had not been feasible if the prize was common knowledge. For instance, Collins et al. (2009) find evidence that spouses save money through agents called 'money guards', who offer the chance to hold the money aside until it is needed for expenditures not sanctioned by the other spouse, or for transfers to the individual's own family. Further, if allocation was already non-cooperative it is possible that asymmetric information gave spouses the opportunity to exercise discretion over how to allocate the private cash windfalls in ways that are Pareto improving. For instance, if the winner of a private windfall believes, based on previous interactions, that sharing information with her spouse about the windfall would result in an allocation that is not of her preference, she may choose to withhold the lottery prize. Withholding the money may then could allow her to spend it on household public goods which would benefit both spouses.

In this section we examine the mechanisms in which cash windfalls differing in the degree of observability by the winner's partner influenced allocations. In particular, we explore whether the effect of private cash prizes on allocations is consistent with income-hiding which would allow the winner to exercise more discretion over how to allocate the windfalls. For spouse i, in household h, and round r, expenditure on good $x^i_{g,h,r}$ can be expressed as:

$$f\left(x^i_{g,h,r}\right) = \sum_{i=0}^{1}\left[\delta^i_{1,g} I^{i,Pu}_{h,r} + \delta^i_{2,g} I^{i,Pr}_{h,r} + \delta^i_{3,g} L^{i,Pu}_{h,r} + +\delta^i_{4,g} L^{i,Pr}_{h,r}\right] + \sum_{r=1}^{5} \sigma_r + \sum_{h=1}^{n} \tau_h + \varepsilon^i_{g,h,r} \quad (9)$$

Where $f\left(x^i_{g,h,r}\right) = ln\left[x^i_{g,h,r} + \sqrt[2]{\left(x^i_{g,h,r}\right)^2 + 1}\right]$, $x^i_{g,h,r}$ is the expenditure on good g by household member i in round r; $I^{i,Pu}_{h,r}$ and $I^{i,Pr}_{h,r}$ correspond to spouse i public and private cash prizes respectively; $L^{i,Pu}_{h,r}$ and $L^{i,Pr}_{h,r}$ correspond to spouse i public and

private livestock prizes respectively. In all specifications we include household (or individual) fixed effects, as well as round fixed effects. Household fixed effects allow us to control for heterogeneity across households with good versus poor marital relationships.

We have examined the effect of lottery windfalls by degree of publicity on individual expenditure on food, household public goods, and private consumption. In this section we examine expenditure on four categories of household goods (food, children, utilities, and home goods), private spousal expenditure (personal care and clothing, and public transportation), and on intra and inter household transfers (chop money, gifts to spouse, gifts to non-household members, and transfers for weddings and funerals)[19]. Dividing private expenditure by each spouse into categories can cause a loss in the precision in which the treatment effects are estimated because there is less variation, and because there is a considerable number of households with zero expenditure in any given round. The proportion of households with zero intra-household gifts, and inter-household gifts and transfers can be as large as 50%. For this reason, for intra and inter-household transfers we estimate linear probability models on dummy variables equal to 1 if spouse i made a gift or transfer in round r, and zero otherwise. Thus for gifts and inter-household transfers we focus on the effect of the lottery prizes on the probability of giving a prize rather than on the amount of the transfer. In the Appendix Table A.3 we present results on random effects Tobit models which show consistent results at the extensive margin.

The expenditure categories differ on the ease by which they can be observed by the winner's partner, on the ease in which committed money can be recovered, and on who benefits from the purchase. Differential impact of public

[19] The results on assets, personal care and gifts were reported in Castilla and Walker (2013), however, the results on food, health, adult clothing and ceremonies expenditures, as well as chop money transfers and loans were not.

versus private cash windfalls on goods that also differ in their degree of publicity can provide information on whether spouses withheld prizes with the objective of maintaining discretion on the way the prizes would be spent. If the winner of a private cash prize wishes to withhold the money from his or her partner she must allocate it towards goods that are not easy to monitor. Alternatively if the winner commits the windfall to private consumption which is not easy to recover, it indicates that the utility derived from the purchase must be larger than the consequences of not sharing the money with his or her partner. Finally, if the winner commits the windfall to household public goods, then his or her partner benefits indirectly from the transfer which can be Pareto improving. Household goods are common knowledge and they benefit both spouses. Clothing and personal care, and public transportation are also observable but only benefit the spouse who consumes them. Gifts and transfers to other households are harder to monitor and recover by the winner's partner as the recipients may have already spent the money, in addition to the social costs of asking to get the money back.

In Table 6 we present results of estimating equation (9) on goods that are observable, both public and private. Household public good purchases respond to husbands' public windfalls by increasing expenditure in utilities (fuel wood, water, etc). Husbands' public cash prizes and wives' private cash prizes increase expenditure on items for the home and the effects are quite large relative to other expenditure categories. Livestock prizes increase expenditure in food. Evidence from the survey indicates that this increase in food expenditure is explained by winning households hosting others for parties where they served the prize as a meal.

Expenditure on assignable private goods responds to both public and private prize winning, but in different ways. From Table 6 we know private prizes won by both spouses increase expenditure in private goods, and that husbands public prizes also increase private consumption. However, husbands' winnings

did not have an effect on their own (or their wives) personal or public transportation expenses. Wives who win cash in private increase their expenditure on personal care and clothing. In Table 6 we also showed that wives' private prizes increase husband's private consumption. From Table 7 it is clear that the effect of these prizes on husbands' private consumption is driven by an increase in expenditure in public transportation. These results indicate that while wives use the private cash prizes for personal benefit, they mostly share them with their husbands either directly through expenditure in public transportation, or indirectly through investment in home goods.

Table 6: Observable Expenditure and Windfalls by degree of Publicity

	Food	Household Public Goods			Husband		Wife	
		Children	Utilities	Home	Personal	Public Transp.	Personal	Public Transp.
Husband Cash Prize Public	0.000	0.002	0.005**	0.016**	0.008	0.006	0.003	0.000
	[0.002]	[0.006]	[0.002]	[0.007]	[0.007]	[0.005]	[0.004]	[0.005]
Husband Cash Prize Private	0.001	0.000	-0.000	-0.003	0.005	0.005	0.004	-0.004
	[0.002]	[0.005]	[0.005]	[0.005]	[0.005]	[0.004]	[0.004]	[0.007]
Husband Livestock Prize Public	-0.000	0.005	-0.004	-0.008*	-0.004	-0.002	0.001	-0.002
	[0.001]	[0.004]	[0.003]	[0.005]	[0.004]	[0.004]	[0.003]	[0.004]
Husband Livestock Prize Private	0.001	-0.007	-0.001	0.006	0.000	-0.001	-0.004	-0.002
	[0.003]	[0.008]	[0.004]	[0.007]	[0.004]	[0.004]	[0.003]	[0.004]
Wife Cash Prize Public	-0.001	0.006	0.001	0.003	-0.000	0.002	0.002	0.004
	[0.003]	[0.008]	[0.003]	[0.007]	[0.003]	[0.004]	[0.002]	[0.003]
Wife Cash Prize Private	0.002	0.001	-0.001	0.022***	0.007	0.010***	0.004*	0.000
	[0.002]	[0.008]	[0.002]	[0.008]	[0.005]	[0.004]	[0.002]	[0.005]
Wife Livestock Prize Public	-0.000	-0.006	-0.006*	-0.000	-0.008**	-0.000	0.002	-0.005
	[0.001]	[0.006]	[0.004]	[0.008]	[0.004]	[0.004]	[0.002]	[0.005]
Wife Livestock Prize Private	0.003**	0.004	0.001	0.003	0.004	0.003	0.002	0.005
	[0.001]	[0.008]	[0.004]	[0.006]	[0.005]	[0.005]	[0.003]	[0.004]
N	1345	1345	1345	1345	1345	1345	1410	1410
R-squared	0.040	0.126	0.009	0.043	0.052	0.014	0.017	0.018

Note: Regressions estimated by linear probability fixed effects.
Standard errors clustered at the individual level in brackets.
Ln (Expenditure) is computed using the Inverse Hyperbolic Sine Transf.
*** p-value<0.01, ** p-value<0.05, * p-value<0.10

In Table 7, we present the results for regressions on intra and inter-household transfers. The first notable result is that, consistent with the survey data

and results in Table 5, neither cash nor livestock prizes, regardless of their degree of publicity, have an effect on chop money transfers. However, when husbands' win public cash prizes they increase the probability of making gifts to their wives. Expenditures in ceremonies correspond to transfers for weddings or funerals. The likelihood of a household making ceremonies transfers to other households increase when wives win public prizes. It is possible that family and friends of wives who win public cash prizes were more likely to have an upcoming wedding or funeral, or alternatively that women are more susceptible to social pressure to share money with their families.

Table 7: Transfers and Windfalls by degree of Publicity

	Spousal Transfers		Net Transfers to Other Households a/		
	Chop Money	Gifts from Spouse	Ceremonies	Husband's Gifts	Wife's Gifts
Husband Cash Prize Public	0.044	0.002**	0.001	0.002	-0.001
	[0.029]	[0.001]	[0.002]	[0.002]	[0.002]
Husband Cash Prize Private	0.012	-0.001	-0.001	0.006***	0.001
	[0.027]	[0.001]	[0.002]	[0.002]	[0.002]
Husband Livestock Prize Public	-0.033	-0.000	0.000	0.000	-0.001
	[0.030]	[0.000]	[0.002]	[0.002]	[0.001]
Husband Livestock Prize Private	0.049	-0.002*	-0.001	0.001	-0.003**
	[0.052]	[0.001]	[0.002]	[0.001]	[0.001]
Wife Cash Prize Public	-0.031	0.001	0.005***	-0.002	-0.000
	[0.042]	[0.001]	[0.002]	[0.002]	[0.002]
Wife Cash Prize Private	0.012	-0.001	-0.001	0.001	0.004**
	[0.035]	[0.001]	[0.002]	[0.002]	[0.002]
Wife Livestock Prize Public	0.127	0.002**	-0.001	0.001	-0.002
	[0.127]	[0.001]	[0.002]	[0.002]	[0.002]
Wife Livestock Prize Private	0.033	0.001	0.002	0.001	0.001
	[0.032]	[0.001]	[0.001]	[0.002]	[0.002]
N	1469	1382	1345	1386	1469
R-squared	0.020	0.037	0.032	0.083	0.064

Note: Regressions estimated by linear probability fixed effects.
Standard errors clustered at the individual level in brackets.
Ln (Expenditure) is computed using the Inverse Hyperbolic Sine Transformation.
a/ the dependent variable is dichotomous, equal to 1 if >0, and 0 if = 0
*** p-value<0.01, ** p-value<0.05, * p-value<0.10

Winning private cash prizes increases the probability that both husbands and wives give gifts to other households. The effects are small, though statistically significant and very robust. In the Appendix Table A.4 we examine the effect of cash prizes on the intensive margin using Random Effects Tobit models, and find that, both husbands and wives, increase their gifts to other households by 2.2 percent. Gifts may be a form of concealment, or at least an effort to keep discretion over the way the money is spent. This interpretation is consistent with Collins et al (2009) and with Udry's (1990) definition of loans in West Africa as a form of contingent claim; loans are almost universally interest-free and with flexible repayment terms, thus lending serves the creditor as a relatively costless store of value and future insurance.

The question remains as whether maintaining discretion over how the money is spent was Pareto improving. While we know cash prizes increased the probability of gifts to other households, we do not know whether these gifts were an investment in social capital or if they were a way to conceal/save the money. In order to examine this question we estimate the effects of prizes won in the previous round on expenditure. Table A.5 in the Appendix contains estimates of equation (9) including current prizes and prizes won in the previous round (Table A.6 contains the Random Effects Tobit estimates). When husbands' win private cash prizes their wives' private expenditure increases in the following round. It is likely that this result reflects either retaliation of the wife for her husband's previous non-cooperative behavior or that the way he spent his cash prize allowed her to reallocate some of her resources towards goods she prefers. On the other hand, when wives win private cash prizes, expenditure in children increases by 1.5% in the next round, which can be Pareto improving.

IV. Conclusions

We presented results from a field experiment in Ghana designed to test for the effect of asymmetric information on household expenditure. The field experiment was conducted between March and November 2009 in conjunction with a year-long household survey in four communities in Akwapim South district of Ghana's Eastern Region. In each community, lotteries were held to distribute prizes at random among survey participants. The prizes varied in value, publicity, and type (cash and livestock).

Results suggest that intra-household allocation is consistent with a non-cooperative marital contract even in the absence of asymmetric information. We find that public cash (or livestock) prizes have no effect on the winner's partner private consumption. However, public cash prizes are spent on utilities and home goods by husbands, and are invested in social capital (transfers for weddings and funerals) by wives. The allocation of prizes towards household public goods benefits both spouses. Husbands also increase the probability of making gifts to their wives when they win cash in public, but not their chop money allowance which would potentially imply committing to larger chop money transfers after the experiment had ended.

Private cash windfalls are spent differently by gender of the recipient. Husbands' who win cash prizes in private increase the probability of making gifts to other households. Wives also allocate private prizes towards gifts to other households, though they also increase their private expenditure in clothes, personal items, and contribute towards their husbands' public transportation expenses and home goods. We also found evidence consistent with wives committing the prize money in the form of gifts in order to exercise discretion over how it would be spent, and that previous private cash prizes increase

expenditure in children in future rounds. Thus, at least wives' allocation of private prizes may be Pareto improving.

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SUPPLEMENTARY APPENDICES: FOR ONLINE PUBLICATION

APPENDIX A: Supplementary Tables and Robustness Checks

A.1. Sample summary

	Village				
	1	**2**	**3**	**4**	**Total**
Husbands	67	64	67	68	266
Wives	67	65	67	70	269
Males Polygamous	3	4	3	0	10
Wives Polygamous	9	9	6	2	26
Single males	4	4	1	4	13
Single females	7	5	6	8	26
Total	157	151	150	152	610

A.2. Lottery Windfalls and Individual Spousal Expenditure, *including lagged prizes*.

	Husband's Ln (Expenditre in …)				Wife's Ln (Expenditre in …)				Net Intra-HH Transfers	
	Total	Private	Food	Household Goods	Total	Private	Food	Household Goods	Chop Money	Gifts to Spouse
Husband Cash Prize	0.009***	0.009**	0.003	0.010***	0.003	0.005	0.001	0.008**	0.003	0.000
	[0.003]	[0.004]	[0.004]	[0.004]	[0.004]	[0.004]	[0.004]	[0.004]	[0.004]	[0.001]
Husband Livestock Prize	-0.001	-0.002	0.004	-0.001	0.003	0.001	0.004	-0.000	0.001	-0.001
	[0.003]	[0.003]	[0.003]	[0.005]	[0.003]	[0.002]	[0.003]	[0.003]	[0.003]	[0.001]
Husband Cash Prize	0.004*	0.003	-0.004	0.008**	0.007*	0.007*	0.005	0.004	0.005	-0.001
Previous Round	[0.002]	[0.004]	[0.003]	[0.004]	[0.004]	[0.004]	[0.004]	[0.005]	[0.004]	[0.001]
Husband Livestock Prize	0.004	0.002	-0.001	0.005	0.003	0.001	0.003	0.006	0.005*	0.001
Previous Round	[0.002]	[0.003]	[0.003]	[0.006]	[0.005]	[0.004]	[0.004]	[0.004]	[0.003]	[0.001]
Wife Cash Prize	0.003	0.005	0.003	0.003	0.005**	0.005***	0.002	0.014***	-0.001	-0.000
	[0.003]	[0.003]	[0.004]	[0.005]	[0.002]	[0.002]	[0.002]	[0.004]	[0.003]	[0.000]
Wife Livestock Prize	-0.001	-0.001	-0.005	-0.007	0.003	0.002	0.003	0.006	0.004	0.000
	[0.004]	[0.004]	[0.005]	[0.005]	[0.002]	[0.002]	[0.002]	[0.005]	[0.003]	[0.000]
Wife Cash Prize	0.004	0.001	0.001	0.007	0.004***	0.008***	0.002	0.009**	0.001	-0.001
Previous Round	[0.003]	[0.003]	[0.004]	[0.004]	[0.002]	[0.002]	[0.002]	[0.004]	[0.003]	[0.001]
Wife Livestock Prize	-0.005*	-0.005*	0.000	-0.016***	-0.002	-0.002	-0.002	-0.003	0.002	0.000
Previous Round	[0.003]	[0.003]	[0.003]	[0.005]	[0.002]	[0.002]	[0.002]	[0.004]	[0.003]	[0.001]
Round FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Individual FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1072	1072	1072	1072	1123	1123	1123	1123	1106	1050
R-squared	0.026	0.023	0.009	0.062	0.018	0.032	0.012	0.035	0.014	0.023

Note: Regressions estimated with individual and round fixed effects.
Standard errors clustered at the household level in brackets.
Ln (Expenditure) is computed using the Inverse Hyperbolic Sine Transformation.
*** p-value<0.01, ** p-value<0.05, * p-value<0.10

A.3. Lottery Windfalls and Transfers, *Random Effects Tobit*.

	Spousal Transfers		Transfers to Other Households a/		
	Chop Money	Gifts to Spouse a/	Ceremonies	Husband's Gifts	Wife's Gifts
Husband Cash Prize Public	0.008	0.010*	0.012	-0.001	-0.012
	[0.006]	[0.005]	[0.010]	[0.015]	[0.015]
Husband Cash Prize Private	-0.000	-0.004	-0.003	0.022*	-0.001
	[0.006]	[0.005]	[0.010]	[0.013]	[0.016]
Husband Livestock Prize Public	-0.001	-0.005	-0.003	0.010	-0.031*
	[0.005]	[0.005]	[0.008]	[0.012]	[0.017]
Husband Livestock Prize Private	-0.000	-0.012**	0.000	-0.000	-0.024
	[0.006]	[0.005]	[0.009]	[0.014]	[0.015]
Wife Cash Prize Public	-0.006	0.002	0.016**	-0.015	0.005
	[0.005]	[0.005]	[0.008]	[0.012]	[0.011]
Wife Cash Prize Private	-0.001	-0.003	-0.008	-0.000	0.023*
	[0.006]	[0.005]	[0.009]	[0.014]	[0.013]
Wife Livestock Prize Public	0.009*	0.009*	-0.010	0.004	-0.010
	[0.005]	[0.005]	[0.009]	[0.013]	[0.013]
Wife Livestock Prize Private	0.007	0.004	0.013	0.011	0.001
	[0.005]	[0.005]	[0.008]	[0.012]	[0.013]
N	1375	1317	1345	1310	1375
Left Censored	284	186	476	695	877

Note: Regressions estimated byfixed effects.
Standard errors clustered at the individual level in brackets.
Ln (Expenditure) is computed using the Inverse Hyperbolic Sine Transformation.
a/ the dependent variable is dichotomous, equal to 1 if >0, and 0 if = 0
*** p-value<0.01, ** p-value<0.05, * p-value<0.10

A.4. Lottery Windfalls and Transfers, *Random Effects Tobit*.

	Fixed Effects					Random Effects Tobits (controlling for Initial Assets)				
	Spousal Transfers		Transfers to Other Households a/			Spousal Transfers		Net Transfers to Other Households		
	Chop Money	Gifts from Spouse a/	Ceremonies	Husband's Gifts	Wife's Gifts	Chop Money	Gifts from Spouse	Ceremonies	Husband's Gifts	Wife's Gifts
Husband Cash Prize Public	0.041	0.002*	-0.000	0.001	0.000	0.007	0.009	0.011	-0.010	-0.009
	[0.032]	[0.001]	[0.002]	[0.002]	[0.002]	[0.006]	[0.006]	[0.009]	[0.015]	[0.015]
Husband Cash Prize Private	0.018	-0.001	-0.002	0.006***	0.002	-0.000	-0.006	-0.003	0.025**	0.000
	[0.026]	[0.002]	[0.002]	[0.002]	[0.002]	[0.006]	[0.006]	[0.009]	[0.013]	[0.016]
Husband Livestock Prize Public	-0.010	-0.000	0.001	0.001	-0.000	0.002	-0.004	-0.001	0.011	-0.037**
	[0.030]	[0.001]	[0.001]	[0.002]	[0.001]	[0.005]	[0.005]	[0.008]	[0.012]	[0.018]
Husband Livestock Prize Private	0.079	-0.002*	-0.001	0.002	-0.003**	0.006	-0.008	0.000	0.004	-0.026
	[0.050]	[0.001]	[0.002]	[0.002]	[0.002]	[0.006]	[0.006]	[0.008]	[0.014]	[0.016]
Husband Cash Prize Public	-0.018	-0.001	-0.002	-0.001	0.002	0.005	-0.001	-0.006	-0.041	0.009
Previous Round	[0.042]	[0.001]	[0.002]	[0.001]	[0.002]	[0.008]	[0.007]	[0.012]	[0.027]	[0.019]
Husband Cash Prize Private	0.014	-0.003	-0.003*	0.001	0.000	-0.010	-0.016**	-0.022*	-0.005	-0.042
Previous Round	[0.045]	[0.002]	[0.002]	[0.002]	[0.002]	[0.008]	[0.007]	[0.012]	[0.018]	[0.029]
Husband Livestock Prize Public	-0.001	-0.002	0.001	-0.000	0.001	0.000	-0.006	0.002	-0.005	-0.017
Previous Round	[0.021]	[0.001]	[0.002]	[0.003]	[0.002]	[0.006]	[0.006]	[0.009]	[0.015]	[0.019]
Husband Livestock Prize Private	0.060	0.002*	-0.003	0.004	-0.001	0.017**	0.011	-0.005	0.024	0.001
Previous Round	[0.046]	[0.001]	[0.002]	[0.003]	[0.003]	[0.007]	[0.007]	[0.010]	[0.017]	[0.016]
Wife Cash Prize Public	-0.049	0.000	0.005***	-0.003*	0.001	-0.009*	0.001	0.017**	-0.016	0.014
	[0.043]	[0.001]	[0.002]	[0.002]	[0.002]	[0.005]	[0.005]	[0.007]	[0.012]	[0.011]
Wife Cash Prize Private	0.025	-0.001	-0.001	0.001	0.004**	0.002	-0.002	-0.008	0.001	0.024*
	[0.035]	[0.001]	[0.002]	[0.002]	[0.002]	[0.006]	[0.006]	[0.009]	[0.014]	[0.014]
Wife Livestock Prize Public	0.110	0.002**	-0.002	0.000	-0.001	0.008	0.007	-0.011	-0.002	-0.001
	[0.120]	[0.001]	[0.002]	[0.002]	[0.002]	[0.005]	[0.005]	[0.008]	[0.013]	[0.013]
Wife Livestock Prize Private	0.034	0.001	0.002	0.002	0.001	0.007	0.003	0.010	0.013	-0.002
	[0.038]	[0.001]	[0.001]	[0.002]	[0.002]	[0.005]	[0.005]	[0.007]	[0.013]	[0.013]
Wife Cash Prize Public	-0.031	-0.001	0.001	-0.001	0.005**	-0.003	-0.004	0.014*	-0.007	0.038***
Previous Round	[0.032]	[0.001]	[0.002]	[0.002]	[0.002]	[0.005]	[0.005]	[0.008]	[0.012]	[0.012]
Wife Cash Prize Private	0.022	-0.001	-0.000	-0.001	0.000	0.004	-0.003	-0.002	0.003	-0.015
Previous Round	[0.029]	[0.001]	[0.003]	[0.002]	[0.001]	[0.006]	[0.006]	[0.010]	[0.016]	[0.020]
Wife Livestock Prize Public	-0.071**	-0.001	-0.000	-0.003	0.002*	-0.006	-0.009	-0.002	-0.023	0.020
Previous Round	[0.034]	[0.001]	[0.002]	[0.002]	[0.001]	[0.006]	[0.006]	[0.009]	[0.016]	[0.014]
Wife Livestock Prize Private	0.036	-0.000	-0.001	0.003*	-0.003*	0.001	0.001	-0.000	0.013	-0.031*
Previous Round	[0.045]	[0.001]	[0.002]	[0.002]	[0.001]	[0.005]	[0.005]	[0.008]	[0.014]	[0.017]
N	1173	1102	1123	1106	1173	1100	1049	1070	1048	1100
Left Censored						237	157	375	584	725

Note: Regressions estimated byfixed effects.
Standard errors clustered at the individual level in brackets.
Ln (Expenditure) is computed using the Inverse Hyperbolic Sine Transformation.
a/ the dependent variable is dichotomous, equal to 1 if >0, and 0 if = 0
*** p-value<0.01, ** p-value<0.05, * p-value<0.10

A.5. Lottery Windfalls and Expenditure, *including lagged prizes*.

	Food	Household Public Goods			Husband		Wife	
		Children	Utilities	Home	Personal	Public Transp.	Personal	Public Transp.
Husband Cash Prize Public	0.001	-0.001	0.005*	0.013**	0.008	0.006	0.003	-0.001
	[0.002]	[0.006]	[0.003]	[0.006]	[0.008]	[0.005]	[0.005]	[0.006]
Husband Cash Prize Private	0.003	0.000	0.004	-0.007	0.002	0.008	0.008**	-0.001
	[0.002]	[0.007]	[0.003]	[0.004]	[0.006]	[0.005]	[0.004]	[0.007]
Husband Livestock Prize Public	0.001	0.006	0.000	-0.009*	-0.006	-0.002	0.002	-0.003
	[0.001]	[0.004]	[0.003]	[0.005]	[0.005]	[0.004]	[0.003]	[0.004]
Husband Livestock Prize Private	0.003	0.001	0.000	0.012*	0.002	0.004	0.000	-0.000
	[0.003]	[0.008]	[0.004]	[0.007]	[0.005]	[0.004]	[0.003]	[0.006]
Husband Cash Prize Public	0.001	-0.021**	0.001	0.020**	0.000	0.004	0.001	-0.007
Previous Round	[0.002]	[0.010]	[0.003]	[0.009]	[0.005]	[0.005]	[0.005]	[0.006]
Husband Cash Prize Private	0.002	-0.002	0.001	-0.003	-0.006	0.003	0.008*	0.005
Previous Round	[0.002]	[0.010]	[0.003]	[0.006]	[0.005]	[0.006]	[0.005]	[0.005]
Husband Livestock Prize Public	-0.001	0.000	0.001	0.004	-0.004	-0.006	-0.002	-0.006
Previous Round	[0.001]	[0.007]	[0.003]	[0.005]	[0.004]	[0.008]	[0.004]	[0.006]
Husband Livestock Prize Private	0.003	0.017	0.005**	0.018***	0.008	0.008*	0.008	0.001
Previous Round	[0.002]	[0.015]	[0.002]	[0.007]	[0.006]	[0.005]	[0.007]	[0.007]
Wife Cash Prize Public	-0.001	0.011	0.001	0.001	-0.000	0.002	0.006*	0.005
	[0.003]	[0.007]	[0.003]	[0.007]	[0.004]	[0.005]	[0.003]	[0.003]
Wife Cash Prize Private	0.002	0.006	-0.001	0.023***	0.011**	0.013***	0.004*	0.003
	[0.002]	[0.008]	[0.003]	[0.008]	[0.005]	[0.004]	[0.002]	[0.006]
Wife Livestock Prize Public	-0.002	-0.015**	-0.004	-0.003	-0.009**	-0.004	0.003	-0.006
	[0.001]	[0.007]	[0.004]	[0.009]	[0.004]	[0.004]	[0.002]	[0.006]
Wife Livestock Prize Private	0.003*	0.001	0.000	0.001	0.003	0.003	-0.000	0.007*
	[0.002]	[0.007]	[0.004]	[0.005]	[0.005]	[0.005]	[0.002]	[0.004]
Wife Cash Prize Public	-0.001	0.010	0.005	-0.005	0.001	0.001	0.009***	0.006
Previous Round	[0.001]	[0.007]	[0.004]	[0.005]	[0.005]	[0.005]	[0.003]	[0.005]
Wife Cash Prize Private	-0.000	0.015**	0.004	0.010	0.004	0.006	0.005*	0.006
Previous Round	[0.002]	[0.006]	[0.004]	[0.007]	[0.003]	[0.004]	[0.003]	[0.005]
Wife Livestock Prize Public	-0.004**	-0.025**	-0.004	-0.006	-0.010*	-0.009	-0.001	-0.003
Previous Round	[0.002]	[0.011]	[0.003]	[0.007]	[0.005]	[0.006]	[0.002]	[0.004]
Wife Livestock Prize Private	0.001	-0.010	-0.000	0.002	0.001	0.000	-0.003	0.000
Previous Round	[0.002]	[0.008]	[0.004]	[0.005]	[0.003]	[0.004]	[0.003]	[0.006]
N	1123	1123	1123	1123	1072	1072	1123	1123
R-squared	0.033	0.131	0.016	0.037	0.036	0.028	0.037	0.026

Note: Regressions estimated with individual and round fixed effects. Standard errors clustered at the household level in brackets.
Ln (Expenditure) is computed using the Inverse Hyperbolic Sine Transformation.
*** p-value<0.01, ** p-value<0.05, * p-value<0.10

A.6. Lottery Windfalls and Expenditure, *including lagged prizes*.

		Household Public Goods			Husband		Wife			Household Public Goods			Husband		Wife	
	Food	Children	Utilities	Home	Personal	Public Transp.	Personal	Public Transp.	Food	Children	Utilities	Home	Personal	Public Transp.	Personal	Public Transp.
Husband Cash Prize Public	0.001	0.004	0.005	0.021	0.003	-0.001	0.006	0.005	0.001	0.001	0.005	0.023	0.006	0.005	0.003	-0.002
	[0.002]	[0.013]	[0.004]	[0.013]	[0.004]	[0.006]	[0.005]	[0.006]	[0.002]	[0.014]	[0.004]	[0.014]	[0.005]	[0.006]	[0.004]	[0.007]
Husband Cash Prize Private	0.002	0.004	0.003	-0.010	0.007*	-0.010	0.003	0.006	0.003	0.004	0.004	-0.011	0.003	0.008	0.009**	-0.009
	[0.002]	[0.012]	[0.004]	[0.014]	[0.004]	[0.007]	[0.006]	[0.006]	[0.002]	[0.013]	[0.004]	[0.014]	[0.005]	[0.006]	[0.004]	[0.007]
Husband Livestock Prize Public	0.000	0.010	-0.002	-0.026*	0.000	-0.006	-0.006	-0.004	0.000	0.010	-0.001	-0.025*	-0.007	-0.005	0.000	-0.009
	[0.002]	[0.010]	[0.003]	[0.013]	[0.003]	[0.006]	[0.005]	[0.006]	[0.002]	[0.011]	[0.003]	[0.013]	[0.005]	[0.006]	[0.003]	[0.006]
Husband Livestock Prize Private	0.001	-0.013	-0.001	0.012	-0.005	-0.003	-0.004	-0.002	0.003	-0.009	-0.000	0.018	-0.002	-0.001	-0.003	-0.001
	[0.002]	[0.011]	[0.004]	[0.011]	[0.004]	[0.006]	[0.006]	[0.006]	[0.002]	[0.012]	[0.003]	[0.012]	[0.006]	[0.006]	[0.004]	[0.006]
Husband Cash Prize Public	-	-	-	-	-	-	-	-	0.001	-0.033*	0.003	0.037**	-0.000	0.003	-0.003	-0.010
Previous Round									[0.003]	[0.018]	[0.005]	[0.017]	[0.007]	[0.008]	[0.005]	[0.008]
Husband Cash Prize Private	-	-	-	-	-	-	-	-	0.001	-0.007	0.005	0.001	-0.005	0.003	0.004	0.005
Previous Round									[0.003]	[0.016]	[0.005]	[0.017]	[0.007]	[0.008]	[0.005]	[0.008]
Husband Livestock Prize Public	-	-	-	-	-	-	-	-	-0.002	-0.005	0.000	0.009	-0.003	-0.010	-0.005	-0.012*
Previous Round									[0.002]	[0.013]	[0.004]	[0.014]	[0.006]	[0.007]	[0.004]	[0.006]
Husband Livestock Prize Private	-	-	-	-	-	-	-	-	0.003	0.017	0.006	0.028*	0.004	0.007	0.008*	0.002
Previous Round									[0.003]	[0.015]	[0.004]	[0.015]	[0.007]	[0.008]	[0.004]	[0.007]
Wife Cash Prize Public	-0.001	0.008	0.001	0.001	0.002	0.006	-0.000	-0.000	-0.001	0.012	0.001	-0.004	0.000	-0.001	0.005	0.008
	[0.002]	[0.010]	[0.003]	[0.012]	[0.003]	[0.005]	[0.005]	[0.005]	[0.002]	[0.011]	[0.003]	[0.013]	[0.005]	[0.006]	[0.003]	[0.005]
Wife Cash Prize Private	0.001	-0.002	-0.001	0.036***	0.005	-0.001	0.004	0.013**	0.001	0.003	-0.001	0.035***	0.007	0.014**	0.005	-0.001
	[0.002]	[0.012]	[0.004]	[0.013]	[0.004]	[0.006]	[0.006]	[0.006]	[0.002]	[0.012]	[0.004]	[0.013]	[0.006]	[0.006]	[0.004]	[0.006]
Wife Livestock Prize Public	-0.000	0.000	-0.001	-0.006	0.002	-0.006	-0.009*	0.004	-0.002	-0.004	-0.001	-0.008	-0.011**	0.004	0.002	-0.007
	[0.002]	[0.011]	[0.004]	[0.012]	[0.004]	[0.006]	[0.005]	[0.006]	[0.002]	[0.011]	[0.003]	[0.012]	[0.005]	[0.006]	[0.004]	[0.006]
Wife Livestock Prize Private	0.003	0.006	0.005	0.003	0.002	0.005	0.005	0.008	0.003	0.003	0.002	-0.003	0.004	0.007	0.001	0.007
	[0.002]	[0.010]	[0.003]	[0.012]	[0.003]	[0.005]	[0.005]	[0.006]	[0.002]	[0.011]	[0.003]	[0.012]	[0.005]	[0.006]	[0.003]	[0.006]
Wife Cash Prize Public	-	-	-	-	-	-	-	-	-0.000	0.011	0.005	-0.010	-0.000	0.000	0.009***	0.009
Previous Round									[0.002]	[0.011]	[0.003]	[0.013]	[0.005]	[0.006]	[0.003]	[0.005]
Wife Cash Prize Private	-	-	-	-	-	-	-	-	-0.000	0.017	0.002	0.010	-0.000	0.006	0.004	0.001
Previous Round									[0.002]	[0.013]	[0.004]	[0.016]	[0.006]	[0.007]	[0.004]	[0.007]
Wife Livestock Prize Public	-	-	-	-	-	-	-	-	-0.004*	-0.021	-0.001	-0.005	-0.012**	-0.003	-0.001	-0.003
Previous Round									[0.002]	[0.013]	[0.004]	[0.013]	[0.006]	[0.006]	[0.004]	[0.006]
Wife Livestock Prize Private	-	-	-	-	-	-	-	-	0.002	-0.009	-0.002	0.007	0.002	0.003	-0.000	-0.000
Previous Round									[0.002]	[0.012]	[0.003]	[0.013]	[0.005]	[0.006]	[0.004]	[0.006]
N	1345	1345	1345	1345	1345	1345	1289	1289	1070	1070	1070	1070	1027	1027	1070	1070
Left Censored	1	486	60	683	69	277	192	247	1	417	41	568	163	197	57	225

Note: Regressions estimated by Random Effects Tobit. Controls: baseline assets. Standard errors clustered at the household/individual level in brackets.
Ln (Expenditure) is computed using the Inverse Hyperbolic Sine Transformation.
*** p-value<0.01, ** p-value<0.05, * p-value<0.10