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Social Preferences and Agricultural Innovation: An Experimental Case Study from Ethiopia

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Summary. — We run an experiment in Ethiopia where farmers can use their own money to decrease the money of others (money burning). The data support the prediction from an inequality aversion model based on absolute income differences; but there is no support for an inequality aversion model based on comparison with mean payoff of others. Experimentally measured money burning on the village level is negatively correlated to real-life agricultural innovations. This result is robust even when data from another independent survey than the current research are used. This underscores the importance of social preferences in agricultural innovations in developing countries.

Key words — social preferences, money burning, agricultural innovations, Ethiopia

1. INTRODUCTION

Research on social preferences in economics has by now amply demonstrated that the welfare of individuals is affected not only by the goods and services they consume but also by the position and actions of others with whom they compare themselves. Most of the literature on social preference focuses on pro-social behavior where cooperation and other regarding behavior lead to better socially beneficial outcomes than predicted by the standard economic model. For example, when punishment is introduced in public good games, people are willing to punish those that free-ride, even at their own expenses, and are reluctant to punish those that cooperate (Ertan, Page, & Putterman, 2009). In trust games, players give substantial proportion of their money to others with the expectation that they will get it back even though they have no control on the decision of the recipients (Cox, 2004). The literature on reciprocity emphasizes mainly its role in strengthening pro-social behavior. One of the celebrated books in this area, Henrich *et al*. (2004), summarizes results of many experimental games and ethnographic studies from fifteen small-scale societies in different parts of the world. The main thrust of this strand of literature is toward understanding how pro-social behavior helps overcome social dilemmas and improve social outcomes. [1]

In contrast, a growing body of literature focuses on the negative aspects of social preferences where the destruction of potential surplus (value) is emphasized. Earlier work by Kirchsteiger (1994) suggested that envy is an equally plausible underlying motive as fairness for rejection of offers in the ultimatum game. Experimental work suggests that people are willing to devote their resources to decrease the welfare of better-off people (Zizzo, 2003; Zizzo & Oswald, 2001) – specifically, they are willing to destroy ('burn') other people's earnings at a cost to themselves. Laboratory experiments also show that subjects are willing to harm for little reason or no self-interest (Abbink & Herrmann, 2009, 2011). Experiments conducted in India show that spiteful preferences – the desire to reduce another's material payoff for the mere purpose of increasing one's relative payoff – are widespread (Fehr, Hoff, & Kshetramade, 2008).

In contrast to the papers cited above that used experimental games, research using survey methods also looked at positional concerns – whether the relative position of people matters. Some of the papers argue that positional concerns become important only at higher levels of income; they argue people in low-income countries are mainly concerned about their absolute positions rather than their relative standing compared to others (Akay, Martinsson, & Medhin, 2012; Clark, Frijters, & Shields, 2008; Frey & Stutzer, 2002). In contrast, others found just the opposite. For example, Corazzini, Esposito, and Majorano (2011) found positional concerns in fact are higher in developing compared to rich countries. Other studies in developing countries also show relative positions matter. A recent study on India (Fontaine & Yamada,

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2014) found three interesting results that support positional concerns are important in developing countries. First, within-caste comparisons reduce well-being; expenditure by others from the same caste triggers stronger envy than providing a positive signal about one's future prospects. Second, between-caste comparisons have a stronger effect than within-caste comparisons. Third, high castes' economic successes are detrimental to low castes' well-being but the reverse is not true. In a different context, a study from Jordan (El-Said & Harrigan, 2009) found strong envy between the Jordanian and Palestinian (immigrant) communities – while Jordanians envy the Palestinians' dominance in the higher wage private sector, Palestinians envy the Jordanians because of the latters' dominance in the public sector. Theesfeld (2004) discusses how distrust and envy creates a formidable constraint for collective action required to maintain irrigation in Bulgaria.

This paper mainly falls within the second strand of literature that focuses on the negative effects of social preferences. To capture this aspect, we employ a money burning experimental design (Zizzo, 2003; Zizzo & Oswald, 2001) in rural villages of Ethiopia, with additional sessions with university students in an urban area. To our knowledge, this is the first study that uses money burning games in a rural setting of a developing country. Our money burning game has two parts: in the first, an unequal distribution of resources is induced by varying initial endowments after which participants play a lottery. In the second round, people are given a chance to use their own money to decrease ('burn') others' money. In addition to exploring the existence and variations of money burning behavior, one of the main objectives of this paper is to understand the underlying motives. Our experimental design provides data for testing the deeper motives for money burning behavior. In particular, we test whether inequality aversion and/or reciprocity/retaliation play a role. There is evidence that players burn money due to inequality aversion based on absolute income differences as suggested by the Fehr and Schmidt (1999) model.

The money burning behavior of participants in the game is likely a reflection of similar behavior in reality. Our particular interest in this regard is to link our experimental results with real-life agricultural innovations. There are many anecdotal evidences in a number of countries of sabotaging behavior which targets better-off individuals. There is at least a potential case that this likely discourages entrepreneurship (Schoeck, 1966). Mui (1995) gives examples from reforming East European countries and China of how sabotaging may have constrained the emergence of entrepreneurs. Caplan (2005) discusses the 'cargo system' in rural Latin America where successful individuals expected to hold offices are required to self-fund and that this may result in an informal tax as high as 80%. He notes how this may discourage innovation and growth. Earlier sociological and psychological work on Ethiopia also emphasizes the pressure toward conformity and the zero-sum nature of social interactions in the country (Korten, 1972; Levine, 1965, 1974).

Agricultural innovations are complex processes that are affected by many factors – there is voluminous theoretical and empirical literature on agricultural innovations in developing countries. Feder and Umali (1993) and Sunding and Zilberman (2001) are good reviews of the literature on agricultural innovations. Ward and Singh (2014) is a recent paper that relates experimental games with agricultural innovations in a developing country.[2] Providing an exhaustive review of the literature is beyond this paper but highlighting some recent findings on agricultural innovations on Ethiopia is instructive.

Most farmers in rural Ethiopia live in a highly unpredictable environment facing such significant environmental shocks like draught; smoothing consumption across time is a real challenge. Dercon and Christiaensen (2011) showed lower consumption due to harvest failure is an important constraint in fertilizer adoption, implying that consumption smoothing is an important determinant of innovation. The influence of social networks in encouraging the spread of information and knowledge and consequently enhancing innovations has been emphasized in the recent literature. Krishnan and Patnam (2013) compared learning from government extension agents and from neighbors in the adoption of fertilizer and improved seeds in Ethiopia. They found that, while the initial impact of extension agents was high, the effect wore off after some time, in contrast to learning from neighbors underlining the importance of social networks. Abebe, Bijman, Pascucci, and Omta (2013) emphasized the market-related quality attributes in the choice of new crops such as improved variety potatoes in Ethiopia – the spread of improved variety potato was constrained by the preference of people for the taste of the local variety.

The growing empirical literature increasingly shows the complex nature of agricultural innovations. Yet the role of social preferences in agricultural innovations is still not well-understood. This paper contributes toward this by linking behavior observed in experimental games with real-life agricultural innovations. For that purpose, this project deliberately uses subjects that were previously covered by a panel household survey to utilize already available data on agricultural innovations. Multi-level mixed effects models that control for village- and session-level random effects are used to identify the link between agricultural innovations and money burning behavior observed in the experimental games. The empirical results show a robust negative correlation between social money burning and agricultural innovations – observed agricultural innovations as captured by an independent previous survey are lower in communities with high rates of money burning. We further use information on three innovations – fertilizer, improved seeds, and rain water harvesting – on which the current research collected data and also found robust and negative correlation between social money burning rates and agricultural innovations. These results imply that the money burning behavior captured by the game in the laboratory most likely captures an unobservable social preference that is inimical to real-life agricultural innovations. The link created between the behavior of participants in the game and their real-life agricultural innovations is the other important contribution of this paper. This is supported by qualitative data coming from sociological reports prepared as part of our project, for example with one of the farmers surveyed reporting that "using better technology might be good in terms of increasing yields. But it also increases the number of enemies one might have. You will be targeted by enemies including wild animals and those who possess the power of the evil eye; they will affect your cattle's fertility as well as the fertility of the soil permanently" (Dessalegn, 2009).

The rest of the paper is organized as follows. Section 2 describes the experimental design and the inequality aversion models predictions. While results are discussed in Section 3, Section 4 provides the conclusions.

2. EXPERIMENTAL DESIGN AND INEQUALITY AVERSION MODELS PREDICTIONS

(a) *Design*

Thirty individuals participate in a session of the experimental game. At the start, players are randomly given large (Birr[3] 15) or small (Birr 7) amounts of money to induce inequality.

We shall call the first high- and the second low-income players. Players know whether they are high- or low-income players. Then players can use any amount of their initial endowment to buy a more than actuarially fair lottery with a 50% chance of winning three times the amount invested. The thirty players are divided into five groups with six players in each group, equally divided into high- and low-income players. Anonymity within each group is strictly maintained, i.e., even though the thirty participants in a session can see each other, with whom they are matched in a group is kept unknown.

After the lottery game, players are informed of what amounts of money the other five members of their group initially received, saved, and how much they have won from the lottery. All six members of a group are then asked how much of the money of others in their group they would like to 'burn'; each player makes five money burning decisions related to each of the other five members of the group. Players cannot burn their own money. They have to pay, however, for burning the money of others; the price of money burning is one tenth of the amount to burn (for example, a player has to pay Birr 1 to decrease another's money by Birr 10). The money burning is separately done for 'safe' (that is, un-invested) money and lottery winnings in order to capture potential heterogeneity.

After eliciting the money burning decisions, a random dictator design is used to determine the actual money to be burnt. Even though the amounts the six players want to burn from the money of the other five are recorded, only the choice of one is implemented after random selection.[4] Subjects learn about the outcome of the game before moving to the next one.

The game is repeated three times (three *stages*). Two sessions of 30 subjects were run in each of the four rural villages (a total of 240 players). In each stage subjects were randomly matched with their group members (*variable groups*). Two variable group sessions were also conducted at Addis Ababa University with 60 students. Additional two sessions in which the same subjects were matched in the three stages (*fixed groups*) were run with 60 students at the university.[5]

At the end of the experiment, participants went home with all the money accumulated over the three stages plus a participation fee of Birr 40. The mean payment, including the participation fees, was around Birr 80, i.e., approximately U.S. $10 or around 4 days of wages for unskilled labor.

(b) *Inequality aversion model predictions*

Economists increasingly recognize that people care about their relative position in addition to their own payoff. The models of Fehr and Schmidt (1999) and Bolton and Ockenfels (2000) are two popular models that formalize this concern specifically concentrating on inequality aversion. In the inequality aversion model of Fehr and Schmidt (1999), players dislike inequality whether it is advantageous or disadvantageous to them; richer people feel 'guilt' and poorer people suffer from 'envy' (this is the reason why the Fehr–Schmidt model is sometimes referred to as the 'guilt/envy' model). Even though people can feel 'guilt' or 'envy' depending on their relative position, the latter motive is stronger than the former – being comparatively rich is better than being comparatively poor. The Fehr–Schmidt utility function has the following form:

$$U_i(x) = x_i - \alpha_i \frac{1}{n-1}\sum_{j\neq i}\max\{x_j - x_i, 0\} - \beta_i \frac{1}{n-1}\sum_{j\neq i}\max\{x_i - x_j, 0\} \quad (1)$$

Here x_i denotes monetary payoff of player i and n represents the number of players. The second term in the utility function measures the loss of utility from disadvantageous inequality ('envy') and the third from advantageous inequality ('guilt'). The assumption that the former is greater than the latter implies $\beta_i \leqslant \alpha_i$ $(0 \leqslant \beta_i < 1)$.

In contrast, the Bolton and Ockenfels (2000) inequality aversion model focuses on the relative position of the individual compared to the mean payoff of other players; note in the Fehr and Schmidt (1999) model, players focus on absolute differences. A simplified version of the Bolton–Ockenfels utility function has the following form (Wilkinson & Klaes, 2012):

$$U_i = U\left(x_i, \frac{x_i}{\sum x_j/n-1}\right) \quad \text{where } j\neq i \quad (2)$$

Here, in addition to the absolute value of their earnings, players compare their payoff with the average payoff of others. In this model, players prefer a payoff that is nearer to the average.

The prediction from these two models of inequality aversion can be directly tested in a multivariate regression framework using our money burning experimental data. To test the Fehr and Schmidt (1999) model, we computed the difference between a player's payoff to that of each of the five members of his/her group within which money burning happens. Note that this variable is negative for players with lower payoff and positive for those with higher payoff – hence, the Fehr and Schmidt (1999) model predicts that money burning should fall with higher values of this variable, other things being equal. To test the Bolton and Ockenfels (2000) model, we computed the ratio of the payoff of a player to the average payoff of the other five players in the money burning group. Note that this ratio will be less (greater) than one if the player's payoff is lower (higher) than the average payoff of the other group members. Hence, the Bolton and Ockenfels (2000) model predicts money burning will fall with higher values of this ratio, other things being equal.[6]

The next section presents the main experimental results. Details on data collection are presented in the Appendix.

3. EXPERIMENTAL RESULTS

In this section we first provide a general overview of the results. We then test for different underlying motives for money burning and examine the relationship between money burning rates and real-life agricultural innovations.

(a) *General overview*

Money burning rates are defined as the amounts of money that subjects burn out of the total money available to burn (i.e., from each of the other players) in percentage terms. Table 1 shows the money burning rates for different groups and survey sites. Note that in each stage players make five pairs of money burning decisions (from safe money and lottery winnings)[7]; for 360 players and for three stages, this constitutes 5,400 pairs of money burning decisions. The figures provided in the first panel of Table 1 are related to these disaggregated money burning decisions. Using these disaggregated figures, the overall mean burning rate is around 8% and the corresponding median is zero; in 56% of the cases, players burned nothing even when there is some money to burn (in 280 cases there was no money to burn since players have used all their money on lottery and lost). That said, the maximum

Table 1. *Descriptive statistics*

	Mean	Median	Max	Std. dev.
Total money burning rates (%) (disaggregated money burning decisions)				
From total payoff	8.16	0	100.00	14.02
From safe money	7.93	0	100.00	15.45
From lottery winnings	9.02	0	100.00	15.78
Total money burning rates (%) (for individual players)				
From total payoff	8.24	6.56	64.18	8.85
From safe money	8.37	5.92	87.21	10.72
From lottery winnings	8.57	5.56	65.22	10.32
Total money burning rates (%)				
Stage 1	11.93	8.48	100.00	14.28
Stage 2	7.67	4.55	69.62	10.52
Stage 3	5.98	2.97	50.00	8.25
Total burning (Birr)				
Stage 1	7.31	5.00	57.00	8.70
Stage 2	4.93	3.00	59.00	7.17
Stage 3	4.09	2.00	35.00	5.72
Overall investment rate (%)	37.80	33.33	100.00	28.18
	Percentile	Centile	95% conf. interval	
Percentiles of total money burning rates (%) (for individual players)				
	10	0.00	0.00	0.00
	20	0.04	0.00	1.19
	30	2.58	1.44	3.44
	40	4.50	3.47	5.29
	50	6.56	5.26	7.48
	60	8.47	7.47	9.33
	70	10.26	9.39	11.40
	80	12.90	11.88	15.00
	90	18.68	16.73	22.72
	100	64.18	64.18	64.18
	Rural		Addis Ababa	
	Variable groups		Fixed groups	Variable groups
Mean money burning rates (%) (urban–rural and fixed and variable groups)				
From un-invested earnings	7.88		12.03	4.71
From lottery earnings	9.16		12.42	5.80
Overall	8.27		11.89	5.47
Mean investment rates on lottery (%)	28.68		49.13	62.93
Male (%)	65.00		93.33	88.33
Age (years)	46.24		21.51	21.35
No education (%)	49.58		0.00	0.00

burning rates of 100% (where players burn all available money) and the relatively high standard deviations indicate that there are significant numbers of high money burning rates.

The second and third sets of money burning rates in Table 1 are aggregated by individual players. Even though in the majority of separate money burning decisions, players did not burn anything (as we have seen above), the median figures are now significantly different from zero when we look at the average decisions of players; there are only 72 players from 360 who did not burn anything in all the three stages. This is also true if the player averages are disaggregated by stages. The percentile distribution of money burning rates given in the middle of Table 1 indicates the wide dispersion. Even though the average money burning rate is about 8%, around 20% of the players on the average burnt more than 18%. The histograms in Figure 1 show the distribution of money burning rates and absolute amounts of money burnt.

No significant differences in money burning rates between safe money and lottery winnings are observed. The money burning rates and the total money burnt decrease in subsequent stages of the game. The relatively low money burning coupled with the random dictator design may have played a role here; when people are not burnt in the first stage, they may tend to burn less in subsequent stages.

Average money burning rates in Addis Ababa are about 12% with fixed and about half as much with variable groups, with the rural rates in-between. There is more money burning within fixed than variable groups, as confirmed by a Mann–Whitney test on the Addis Ababa sample ($P = 0.05$).[8] On the other hand, there is no significant difference in money burning rates between variable groups in Addis Ababa and rural villages.

Result 1. Money burning rates are higher with fixed groups than with variable groups.

Players invest around 38% of their endowment on the lottery on average. This average figure hides the significant difference in investment rates between the university sample and the farmers in rural areas; while average investment rate of the former is 56% that of the latter is only 29%. The spread of investment

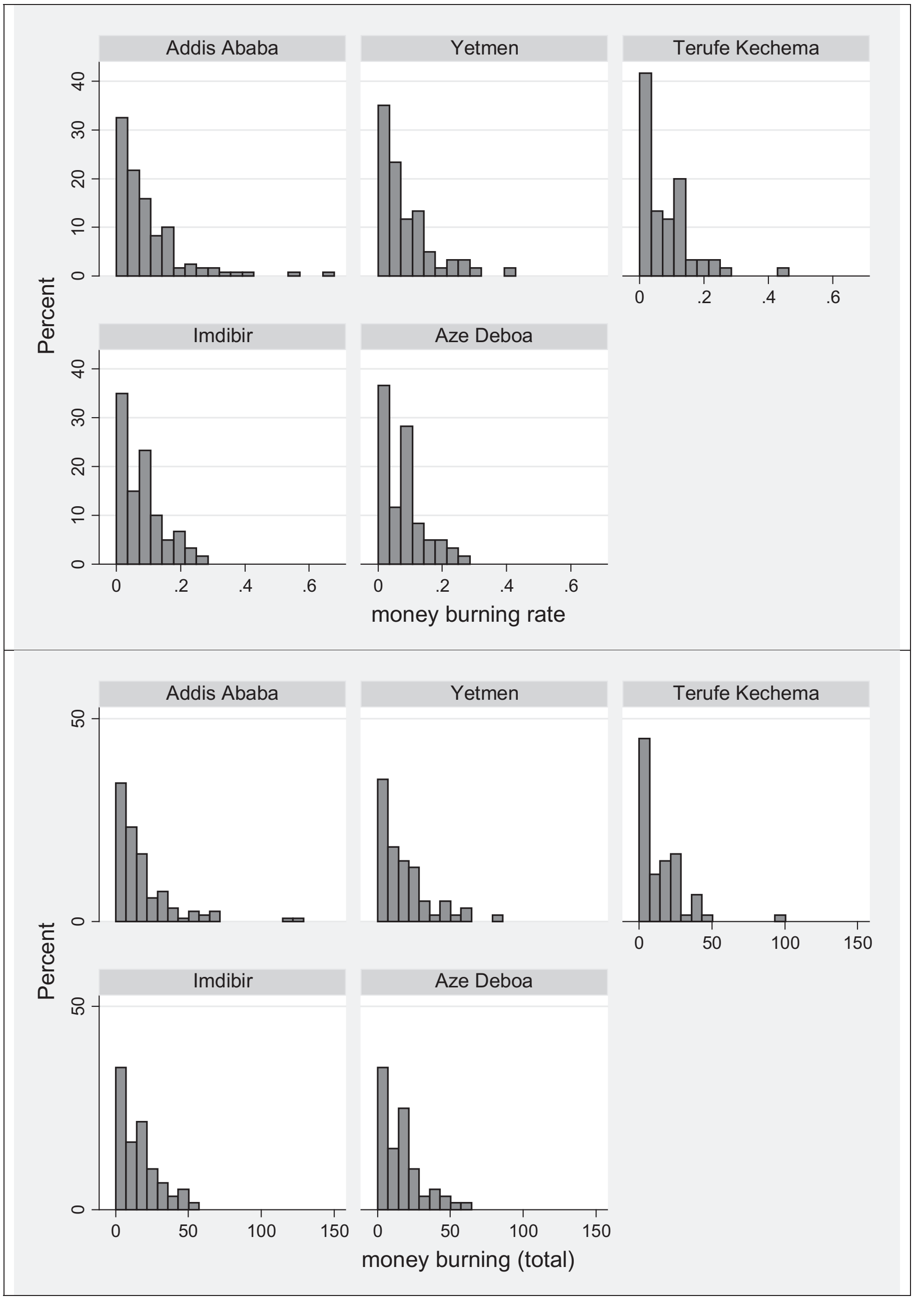

Figure 1. *Histograms of money burning rates (upper panel) and amount of money burning by sites (lower panel) (mean at player level for all three stages).*

rates and the difference between the urban and rural samples is clearly illustrated by the histograms in Figure 2.

The above figures imply that rural subjects are more risk averse than Addis Ababa students, as revealed by their choices to invest less in the lottery (Mann–Whitney $P < 0.001$). We suspect a combination of three factors likely explains this difference. First, there is evidence that risk aversion increases with age (e.g., Albert & Duffy, 2012); the average age of the rural sample is around 46 years with the corresponding figure for the students being 21 (look at Table 1). Second, there is evidence that risk aversion falls with increases in cognitive ability (e.g., Dohmen, Falk, Huffman, & Sunde, 2010). Particularly, in our case the comparison is between farmers who are largely uneducated (50% of whom are without any education) and students that are selected through highly competitive academic entrance procedures for their university education. Third, there is evidence that females are more risk averse than males (e.g., Borghans, Golsteyn, Heckman, & Meijers, 2009). In the rural sample, 65% are males; the proportion increases to 90% with university students. The dominance of males in the university sample is a third potential explanatory factor.

Result 2. Rural subjects are more risk averse.

The next section will shed more light on the possible underlying motives for money burning, particularly focusing on inequality aversion and reciprocity/retaliation.

(b) *Money burning, inequality aversion, and reciprocity*

To test the two inequality aversion models as described in Section 2(b), we used the disaggregated experimental game data. Note that, in each stage, each player is matched with five other players and is given information on what amount of

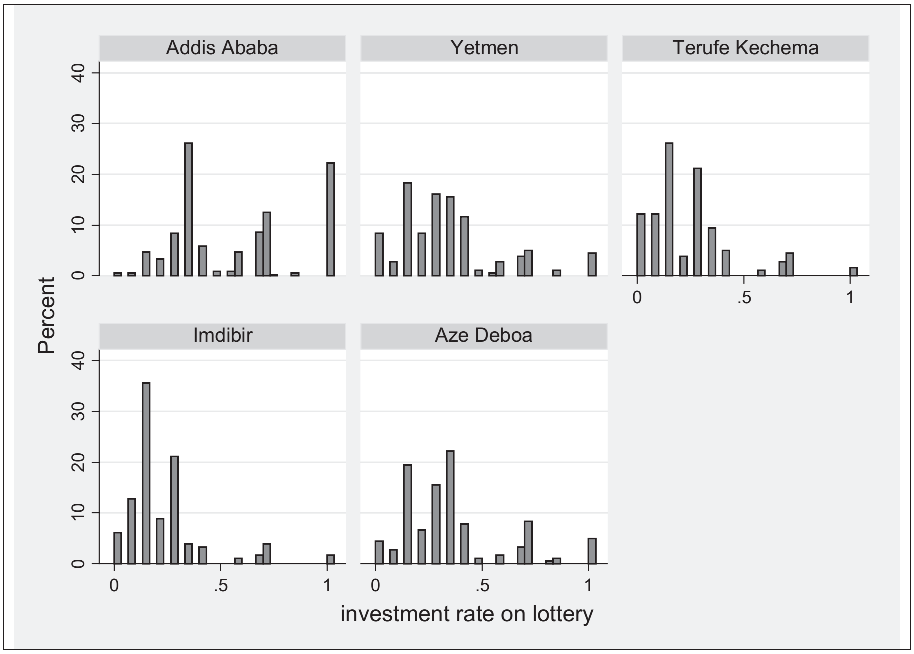

Figure 2. *Histograms of investment rates by sites (all rounds).*

money they have and is asked how much he/she would like to burn. In total there are 360 players and with three stages and five decisions of money burning for each stage the total number of observations adds up to 5,400 providing ample degrees of freedom. The money burning rate, as defined above, is the percentage of money a player would like to burn from the total money (safe money plus lottery winning) of another player in the group at that stage. The money burning rate is regressed on the above-defined inequality aversion variables, the total income of the money burner, whether the other player is a high- or low-income player and location and game related dummy variables. In a significant number of cases, players decided to burn nothing (money burning rate is zero); to handle the censoring problem we used panel tobit models with individual-level random effects. Four variations of the regressions are reported in Table 2. In the first and second models the absolute income difference and ratio of own income to average income of others are entered separately; in both, game-related variables and location dummies are included. In the third and fourth regressions, both inequality aversion variables are included; in the fourth, additional socio-demographic variables are controlled for.

The coefficients on absolute total income differences are consistently negative and highly significant; in other words, the higher the difference between the payoff of a player and other players, the higher the player burns their money. This supports the prediction of the Fehr and Schmidt (1999) inequality aversion model. The positive and consistently significant coefficient on high-income players also supports inequality aversion; players tend to burn more money from those that received higher amounts of initial money.

Result 3. Players burn more money when the absolute difference between their payoff and the payoff of others increases – this finding supports the predictions from Fehr and Schmidt (1999) inequality aversion model.

In contrast, all the coefficients on the ratio of own income to the average income of the others is consistently positive and highly significant. In other words, the data do not support the prediction from the Bolton and Ockenfels (2000) model; when the ratio of own payoff relative to that of other group members increases, players tend to burn more money, exactly the opposite of the prediction from the model. Part of the reason for this result is most likely related to an income effect. Note that money burning is a costly mechanism of redistributing income – players pay one-tenth of the value of the money they would like to burn. If players with a higher payoff burn more because they can 'afford' to do so (an income effect), it will make the coefficients positive since the ratio is positively correlated to the player's own payoff. This seems to be confirmed by the positive coefficient on the total income of the money burner in specification (1) which becomes no longer significant when the income ratio variable is added. This is as a consequence of multicollinearity between the two variables. Hence, in addition to the fact that income of the player directly enters into the ratio, the significance of the regression coefficients indicate the income ratio variable is partly capturing an income effect.[9] The income effect does not fully explain the positive coefficient.

Result 4. The data from the money burning game do not support the prediction of the Bolton and Ockenfels (2000) model of inequality aversion.

To summarize, while there is a robust support for the prediction of the Fehr and Schmidt (1999) model, the available evidence from the data does not support the Bolton and Ockenfels (2000) model. In fact, the coefficients suggest the opposite of what the Bolton and Ockenfels (2000) model predicts.

The other possible motive for money burning is reciprocity/retaliation. The money burning game used the random dictator design; from all the money burning decisions made by the six group members, the decision of only one is randomly selected and implemented. The actual amount of money burnt in the previous stage can trigger retaliatory money burning in the current stage. Particularly, this motive can be stronger in the fixed groups since the identity of the group members is kept the same in all stages; in other words, the person who has burnt your money will still be in your group in the next stage. But in the case of the variable groups, in every stage players are matched with other players and if there is a retaliatory motive it will of a 'generalized' nature; that is, people

Table 2. *Absolute and relative inequality aversion: Panel tobit models (individual level random effects)*

Variables	(1)	(2)	(3)	(4)
Absolute total income difference	−0.0036***		−0.0043***	−0.0042***
	(0.0005)		(0.0005)	(0.0005)
Ratio of own income to average of others		0.0342***	0.0519***	0.0509***
		(0.0084)	(0.0087)	(0.0089)
Total income of money burner	0.0053***	−0.0015	0.0014	0.0016
	(0.0007)	(0.0009)	(0.0010)	(0.0010)
High-income player (the other player)	0.0225***	0.0517***	0.0163**	0.0175**
	(0.0078)	(0.0066)	(0.0078)	(0.0079)
Socio-demographic variables				
Male (dummy)				−0.0031
				(0.0317)
Age (log)				0.0410
				(0.0546)
No education (dummy)				0.0088
				(0.0342)
Game related variables				
Afternoon session	0.0053	0.0094	0.0058	0.0078
	(0.0241)	(0.0241)	(0.0243)	(0.0253)
Stage 2	−0.0818***	−0.0784***	−0.0809***	−0.0835***
	(0.0078)	(0.0077)	(0.0077)	(0.0078)
Stages 3	−0.1270***	−0.1138***	−0.1219***	−0.1224***
	(0.0081)	(0.0080)	(0.0081)	(0.0082)
Variable groups	−0.1384***	−0.1267***	−0.1411***	−0.1385***
	(0.0423)	(0.0421)	(0.0426)	(0.0431)
Location dummies (Addis Ababa baseline)				
Yetmen	0.0900**	0.0882**	0.1040**	0.1005**
	(0.0423)	(0.0422)	(0.0428)	(0.0432)
Terufe Kechema	0.0728*	0.0594	0.0811*	0.0846*
	(0.0425)	(0.0423)	(0.0429)	(0.0436)
Imdibir	0.0969**	0.0843**	0.1064**	0.1403**
	(0.0423)	(0.0421)	(0.0427)	(0.0560)
Aze Deboa	0.0697	0.0660	0.0820*	0.1087*
	(0.0424)	(0.0422)	(0.0428)	(0.0563)
Constant	−0.0313	0.0002	−0.0407	−0.2011
	(0.0332)	(0.0327)	(0.0335)	(0.2041)
Sigma_u	0.2149***	0.2142***	0.2168***	0.2177***
	(0.0108)	(0.0107)	(0.0109)	(0.0110)
Sigma_e	0.1843***	0.1834***	0.1829***	0.1832***
	(0.0030)	(0.0030)	(0.0030)	(0.0030)
Observations	5,121	5,121	5,121	5,031
Number of players	360	360	360	354

Note: The dependent variable in these regressions is the money burning rate, i.e., the ratio of money burnt to total payoff (safe money plus lottery winnings). Standard errors in parentheses;
*** $p < 0.01$.
** $p < 0.05$.
* $p < 0.1$.

would start to burn more even though the person that has burnt their money may no more be in their group.

To test for the potential existence of a retaliatory motive, money burning rates are regressed on actual money burnt in the previous stage (lagged actual money burnt). If this motive is important in money burning, this variable will have a positive and significant coefficient. Note that since there is no lagged actual money burnt for the first stage, the regressions use data from only the second and third stages (look at Table 3).

In all the four specifications reported in Table 3, the coefficients on lagged actual money burnt are never significant. Particularly note that in the fourth specification we have added an interactive term between lagged actual money burnt and the dummy variable for variable groups. If retaliation was an important motive at least in the fixed groups, this interactive term would have become significant; the coefficient is not significant. Hence, retaliation does not seem to be an important motive for money burning also in the fixed group versions of the game.

Result 5. Reciprocity/retaliation is not an important motive behind money burning in our experiment. This is true even if we particularly focus on the fixed groups where the identity of the members is kept the same across stages of the game.

So far we looked at the underlying motive for money burning and found that the data support the prediction of the Fehr and Schmidt (1999) model which focuses on absolute income

Table 3. *Retaliatory motive for money burning: Panel tobit models (individual level random effects)*

Variables	(1)	(2)	(3)	(4)
Lagged actual money burnt	0.0032	0.0007	0.0009	−0.0014
	(0.0027)	(0.0028)	(0.0028)	(0.0053)
Lagged actual money burnt*variable group				0.0031
				(0.0061)
Total income of money burner	0.0001	0.0002	0.0003	0.0003
	(0.0007)	(0.0007)	(0.0007)	(0.0007)
High-income player (the other player)	0.0450***	0.0447***	0.0456***	0.0456***
	(0.0077)	(0.0077)	(0.0078)	(0.0078)
Male (dummy)			0.0049	0.0054
			(0.0325)	(0.0325)
Age (log)			0.0648	0.0641
			(0.0561)	(0.0561)
No education (dummy)			0.0021	0.0032
			(0.0351)	(0.0352)
Afternoon session		0.0142	0.0182	0.0316
		(0.0248)	(0.0258)	(0.0440)
Stages 2		0.0295***	0.0276***	0.0303
		(0.0083)	(0.0084)	(0.0443)
Variable groups		−0.0725*	−0.0675	0.0950*
		(0.0432)	(0.0438)	(0.0571)
Yetmen		0.0351	0.0318	0.0504
		(0.0435)	(0.0441)	(0.0577)
Terufe Kechema		0.0292	0.0309	0.0174
		(0.0436)	(0.0443)	(0.0258)
Imdibir		0.0507	0.0956*	0.0275***
		(0.0431)	(0.0572)	(0.0084)
Aze Deboa		0.0132	0.0502	−0.0715
		(0.0435)	(0.0577)	(0.0444)
Constant	−0.1172***	−0.0994***	−0.3557*	−0.3499*
	(0.0177)	(0.0346)	(0.2102)	(0.2103)
Sigma_u	0.2135***	0.2125***	0.2139***	0.2137***
	(0.0122)	(0.0122)	(0.0124)	(0.0124)
Sigma_e	0.1500***	0.1493***	0.1494***	0.1493***
	(0.0035)	(0.0035)	(0.0035)	(0.0035)
Observations	2,827	2,827	2,772	2,772
Number of players	360	360	354	354

Note: The dependent variable in these regressions is the money burning rate, i.e., the ratio of money burnt to total payoff (safe money plus lottery winnings). Standard errors in parentheses.
* $p < 0.1$.
** $p < 0.05$.
*** $p < 0.01$.

differences. In contrast, the inequality aversion model that focuses on relative income comparison with the average income of other players as captured by the Bolton and Ockenfels (2000) model is not supported by the data. In addition, retaliation is not a significant motive for money burning.

In the next section, we examine if money burning captured in the game is related to real-life agricultural innovations.

(c) *Agricultural innovations and money burning*

One of the main objectives of this research is to understand how social preferences captured by money burning games are related to real-life agricultural innovations. We shall examine these issues first by combining the experimental data from the current project with household data from the Ethiopian Rural Household Survey (ERHS) [10] and second using additional data on agricultural innovations collected by the current research project. The use of two data sets generated by entirely independent data generating processes provides credence to our results. Note that the first part of this section uses data only from rural participants that were covered by the ERHS.

Money burning observed in the experimental game likely proxies for some unobserved social preference in real life and agricultural innovation is expected to be affected by these social preferences through three different channels. [11] First, individual money burning likely captures relevant individual characteristics correlated to innovation. For example, people burning others' money are likely more aggressive and/or competitive and hence we hypothesize that these characteristics may be correlated to innovative behavior. Second, the money burning of others (*social money burning*) is expected to affect innovation; a farmer in a community with high social money burning will be discouraged to invest as some of the returns from investment will be destroyed by others. [12] Third, the interaction between individual and social money burning is also an important factor. Even if a positive correlation between individual money burning and innovation is expected, if everybody in the community behaves similarly the net effect may be different depending on feedback effects (externality).

Given other determinants, the innovation function can be presented as follows:

$$I_{hv} = f\left(MBR_{hv}{}^{h}, MBR^{v}_{hv}, MBR^{h}_{hv} \times MBR^{v}_{hv}/IN_{hv}, S_{sv}, V_{v}\right) \quad (3)$$

In Eqn. (3) the subscripts h and v index households and villages respectively; in our sample the households are from four villages hence v runs from 1 to 4. I_{hv} stands for innovations implemented by household h in village v, MBR^{h}_{hv} and MBR^{v}_{hv} stand for individual and social money burning rates and IN_{hv}, S_{sv} and V_{v} represent individual-, session-, and village-level effects that affect innovations. $MBR^{h}_{hv} \times MBR^{v}_{hv}$ stands for the interactive term between individual and social money burning rates included to capture the externality (feedback) effects.

To measure the overall adoption rates of households (I_{hv}) a simple innovation index is computed using the ERHS data. This index captures twelve agricultural innovations; farmers were asked whether they grow new crops like coffee and *chat*,[13]

Table 4. *Innovation index (from Ethiopian Rural Household Survey and from the data collected in this research project)*

(1) ERHS				(2) Money burning project			
Innovation index	Frequency	Percent	Cum. Freq.	Innovation index	Frequency	Percent	Cum. Freq.
1	19	12.67	12.67	0	42	21.65	21.65
2	21	14.00	26.67	1	57	29.38	51.03
3	30	20.00	46.67	2	76	39.18	90.21
4	29	19.33	66.00	3	19	9.79	100.00
5	21	14.00	80.00				
6	22	14.67	94.67				
7	6	4.00	98.67				
8	2	1.33	100.00				
Total	150	100.00		Total	194	100.00	

Table 5. *Innovations (ERHS) and money burning: Multi-level regressions (site and session levels random effects)*

Variables	(1)	(2)	(3)	(4)
Investment rates on lottery game	0.0522	−0.0602	0.0809	−0.1220
	(0.6176)	(0.6173)	(0.6133)	(0.6356)
Money burning rate from safe money	−0.7805	−4.5530**	−41.0097**	−31.7879
	(1.7274)	(1.9655)	(20.4330)	(20.2959)
Money burning rate from lottery win	0.3017	−4.0992***	13.9574	15.3235
	(1.4215)	(1.5724)	(16.1412)	(15.5910)
Safe money social burning rate for PA		−224.4653***	−257.6613***	−250.0944***
		(51.5005)	(55.5914)	(60.4536)
Lottery win social burning rate for PA		−258.0384***	−241.1391***	−222.4717***
		(43.7726)	(46.9992)	(51.1965)
Individual*social money burning rates (safe money)			478.5592*	370.9191
			(264.1420)	(261.1661)
Individual* social money burning rates (lottery win)			−199.7049	−219.0262
			(181.0975)	(174.8396)
Male (dummy)				0.7638***
				(0.2395)
Age (log)				−0.2122
				(0.3942)
No education (dummy)				0.0326
				(0.2363)
Constant	3.9321***	45.4322***	46.4347***	44.4326***
	(0.6375)	(7.2030)	(7.6368)	(8.3208)
Study site var(_cons)	0.1791	−1.1291**	−1.1183**	−0.9836**
	(0.3639)	(0.4995)	(0.4925)	(0.4589)
Session var(_cons)	−25.7324***	−14.3079	−14.3235	−17.1825**
	(8.0622)	(2,368.6676)	(2,284.4102)	(7.3763)
Var(Residual)	0.2301***	0.2301***	0.2137***	0.1769***
	(0.0585)	(0.0585)	(0.0585)	(0.0587)
Observations	150	150	150	149
Number of groups	4	4	4	4

Note: The dependent variable in these regressions is the innovation index computed from the Ethiopian Rural Household Survey (ERHS) in relation to each subject which took part in the ERHS. Standard errors in parentheses.
*** $p < 0.01$,
** $p < 0.05$,
* $p < 0.1$.

whether they have improved livestock, use modern agricultural inputs, farm other new crops, use irrigation, water holes, improved seeds and/or fertilizer, whether they were selected as model farmers, participated in soil conservation, or rain harvesting programs. If their responses are affirmative a score of 1 is given for each of these innovations; if not, they get a score of 0. The simple sum of these scores provides an index of innovation. For example, a farm household that adopted all the twelve innovations will have a score of twelve and a household that has not adopted any will have a score of zero.[14]

Households on average have adopted around four of the innovations (mean = 3.75) and at least one innovation has been adopted by all households with the most innovative households implementing eight (look at the figures under (1) ERHS in Table 4).

Community level *social money burning rates* (MBR^{v}_{hv}) are computed in the following way. For each individual the average money burning rates of all *other* individuals (i.e., excluding the individual's money burning rate) in the village is computed. Social effects should reflect what each individual expects on the average from the rest of the people in the village.

To estimate Eqn. (1) the innovation index is regressed on individual and social money burning rates and the interaction between the two in addition to other controls. The regressions are estimated using multi-level mixed effects models with survey site and session level random effects to control for unobservable effects at those levels. The same model is estimated by including different variables to see if results are robust to inclusion and exclusion of variables.

In most cases, individual money burning rates – both from safe money and lottery wins – are not significant. In the three cases they become significant, they have the opposite sign to our initial expectation. There is no robust correlation between the individual money burning rates and their investment in real agricultural innovations.

The highly significant, consistent, and robust result from the regressions reported in Table 5 is related to social money burning rates for both safe money and lottery winnings. For both variables and for all specifications, the coefficients on the social money burning rates are highly significant and as expected negative. The results strongly suggest that money burning in the experimental games likely captures an important aspect of social preference which is inimical to agricultural innovations particularly on the community level. In communities where the money burning rate is high, famers innovate significantly less. On the other hand, the interactive terms between individual and social money burning are not significant (only one being significant merely at 10% level). This result suggests there is no strong feedback (externality) effect in money burning behavior.

Note that the detailed information on agricultural innovations used so far comes from the ERHS, a survey that was

Table 6. *Innovations (fertilizer, improved seeds, and rain harvesting) and money burning: Multi-level regressions (site and session levels random effects)*

	(1)	(2)	(3)
Investment rates on lottery game	0.6957**	0.6593*	0.4121
	(0.3408)	(0.3424)	(0.3439)
Money burning rate from safe money	−2.1188**	9.5834	12.7837
	(1.0207)	(11.7617)	(11.2962)
Money burning rate from lottery win	−0.4684	6.7307	7.5390
	(0.8341)	(8.9468)	(8.4291)
Safe money social burning rate for PA	−61.2423***	−48.7662**	−49.9196**
	(20.2190)	(23.1956)	(23.5538)
Lottery win social burning rate for PA	−89.8015***	−81.9200***	−72.7667***
	(17.3827)	(19.6132)	(19.9101)
Individual*social money burning rates (safe money)		−150.6836	−185.9199
		(151.8993)	(145.4998)
Individual* social money burning rates (lottery win)		−82.5129	−94.4218
		(101.1747)	(95.2679)
Male (dummy)			0.5175***
			(0.1252)
Age (log)			0.1764
			(0.2084)
No education (dummy)			−0.2093*
			(0.1261)
Constant	14.2640***	12.5871***	10.9913***
	(2.8276)	(3.1176)	(3.1988)
		−2.4458**	−2.2344***
Study site var(_cons)	−2.3564**	(1.1753)	(0.7286)
	(1.0002)	−2.9982	−24.3847***
Session var(_cons)	−3.3579	(4.2436)	(9.1970)
	(8.3410)	−0.2182***	−0.2798***
Var(Residual)	−0.2145***	(0.0520)	(0.0514)
	(0.0520)		
Observations	194	194	193
Number of groups	4	4	4

Note: The dependent variable in these regressions is the innovation index computed from the data set collected by the current research project. Standard errors in parentheses.
*** $p < 0.01$.
** $p < 0.05$.
* $p < 0.1$.

conducted independently of the current research. In the current research project, data on agricultural innovations, particularly focusing on the use of fertilizer, improved seeds, and rain harvesting, were collected. Similar to the above procedure, we computed a simple innovation index capturing the adoption of the three innovations by households; for each innovation adopted by the households, a score of 1 is given otherwise 0. Hence, households adopting all three will have an innovation index of 3 and those who have not adopted any will have a score of 0. The mean innovation index for the sample is 1.37, meaning that on the average households have adopted less than two innovations. Around a fifth of the sampled households have not adopted any one of the three (figures under '(2) Money burning project' in Table 4).

As in the previous case, this new innovation index is regressed on individual and social money burning rates and their interaction in addition to some control variables. Multi-level mixed models with site and session levels random effects are estimated (look at Table 6).

Like in the previous case, individual money burning rates are not significantly correlated to the innovation index. All the social money burning rates for both safe money and lottery winnings on the other hand are highly significant and negative. The results from the previous regressions are confirmed. As indicated before, since the ERHS and the current project generated these data sets independently, one can be more confident on this robust result. Social money burning on the community level is robustly and negatively correlated to agricultural innovation as illustrated from the results of the two independent data sets. As in the previous case, the interaction terms between individual and social money burning rates are not significant.

Result 6. Higher social money burning rates at the village level are negatively and robustly correlated to agricultural innovations measured by indices based on the ERHS as well as data collected by the current research. This implies that the money burning behavior captured in the experimental games captures social preferences that are inimical to real-life agricultural innovations.

So far, indices that capture the overall number of innovations from two independent data sets are used as measures of agricultural innovations. An alternative is to look at individual innovations. In Table 7, regression results from multi-level probit models using specific innovations (fertilizer, improved seeds, and rain harvesting) are presented. The results from these probits generally support the results from innovation indices. In all specifications, individual money burning from safe money as well as from lottery winnings is not significantly correlated to the specific innovations. Similar to the previous results, most of the coefficients on the social money burning rates from safe money and lottery wins are negative and significant. From the twelve coefficients seven are highly significant and negative; in all the twelve cases coefficients are consistently negative. It is interesting to note that

Table 7. *Specific innovations and money burning: Multi-level probit regressions*

Variables	(1) Fertilizer	(2) Improved seeds	(3) Rain harvesting	(4) Fertilizer	(5) Improved seeds	(6) Rain harvesting
Investment rates on lottery game	0.7168	1.8672***	−0.4564	0.3924	1.7913**	−0.8087
	(0.7423)	(0.6326)	(0.7904)	(0.8826)	(0.7104)	(0.8702)
Money burning rate from safe money	1.7007	15.4791	20.1726	6.9161	29.5874	25.3777
	(38.5041)	(20.8804)	(24.1502)	(43.1485)	(23.3745)	(25.1445)
Money burning rate from lottery win	19.3796	15.4288	−3.3495	20.8923	20.7466	−4.3190
	(27.2593)	(16.5533)	(22.3195)	(29.6692)	(18.1861)	(22.8312)
Safe money social burning rate for PA	−6.0111	−78.9846**	−43.0317	−9.9455	−87.8358*	−42.2550
	(59.3255)	(40.0564)	(39.9752)	(71.7952)	(47.3210)	(41.0427)
Lottery win social burning rate for PA	−128.4483***	−67.9062**	−126.7073**	−132.2366***	−55.0200	−135.4135***
	(41.0269)	(34.4172)	(49.5069)	(50.9432)	(40.1073)	(52.3205)
Individual*social m. burning rates (safe money)	−26.8987	−244.9709	−301.8285	−89.7684	−414.7643	−367.0172
	(509.6125)	(267.5987)	(314.7038)	(570.6215)	(298.3167)	(326.8493)
Individual* social m. burning rates (lottery win)	−232.5595	−173.0377	34.7478	−254.4901	−239.3083	40.0589
	(295.6409)	(186.2598)	(261.3861)	(320.1827)	(204.2425)	(267.3850)
Male (dummy)				0.7473**	1.1305***	0.0424
				(0.3313)	(0.2488)	(0.3053)
Age (log)				0.7745	0.3450	−0.4131
				(0.4853)	(0.3811)	(0.4934)
No education (dummy)				−0.5729*	−0.2820	−0.1163
				(0.3036)	(0.2335)	(0.2948)
Constant	12.9974*	11.9547**	13.7894**	10.7096	9.5303	16.2208**
	(6.6510)	(5.4718)	(6.7375)	(8.3843)	(6.4720)	(7.2627)
var(_cons[site])	0.0441	0.0000	0.0000	0.0907	0.0549	0.0000
	(0.0702)	(0.0000)	(0.0000)	(0.1270)	(0.0715)	(0.0000)
var(_cons[site>session])	0.0000	0.0584	0.0000	0.0121	0.0000	0.0000
	(0.0000)	(0.0764)	(0.0000)	(0.1116)	(0.0000)	(0.0000)
Observations	194	194	194	193	193	193
Number of groups	4	4	4	4	4	4

Note: The dependent variable in these regressions is a dummy variable representing adoption of the given innovation based on the data set collected by the current research project. Standard errors in parentheses.

*** $p < 0.01$.

** $p < 0.05$.

* $p < 0.1$.

all but one of the coefficients on social money burning from lottery wins are significant. The weight of the evidence in this section clearly shows a strong and robust negative correlation between social money burning rates and agricultural innovations. Some of the evidence for this is derived using data that were collected by another survey independently of the current research; hence, this provides strong support to the results. Contrary to our expectation, individual money burning rates are not significantly correlated to innovation activities. In addition, the interaction between individual and social money burning behavior does not create an external feedback effect.

As indicated before, sociological reports were prepared by university lecturers and eight focus group discussions were conducted as part of this research in addition to the experimental game. The qualitative data from these sources strongly suggest behavior similar to money burning in real-life activities. For example, envy is considered by most as an automatic consequence of success and achievement, as illustrated by the farmer's quote in the introduction. The sociological reports provide stories of destructive behavior even among close family members. [15]

In this paper we focused on agricultural innovations; but note that farmers are also involved in non-agricultural innovations. In the long-term, since dependence on agriculture is expected to decline with economic growth, non-agricultural innovations are expected to become more important. Some of the anecdotal evidence from the qualitative data indicates that sabotaging behavior becomes even stronger in relation to activities that are very different from farming. Extension agents indicate that the problem is stronger when innovations are very novel (Tiumelissan, 2009). Since this research focused only on agricultural innovations, the problem is likely to be more severe if non-agricultural innovations are considered. At a general level, growth of non-agricultural sectors is crucial in the structural transformation of economies and sabotaging (and fear of sabotaging) can become an important obstacle to development.

4. CONCLUSION

We presented an experiment on money burning primarily run with Ethiopian farmers. Money burning rates were lower than observed without the social pressures of the field environment. While the data support the inequality aversion model of Fehr and Schmidt (1999), there is no evidence for the alternative inequality aversion model of Bolton and Ockenfels (2000). Reciprocal/retaliatory motives do not play an important role in our experiment. Furthermore, money burning, particularly money burning on the level of communities, is robustly and negatively correlated to agricultural innovations. To our knowledge, this is the first paper that captures money burning behavior using experimental games and examines their effect on real-life innovations.

There are three take home messages for policy makers from this research. First, sabotaging behavior proxied in this research by money burning matters for adoption, even when controlling for a number of other variables. Second, while changing preferences may be difficult, there may be institutional changes that can be made to help channel such preferences in a productive rather than a destructive direction, as argued by Grolleau, Mzoughi, and Sutan (2009). Third, the negative effect may be minimized if innovations are adopted by significantly large number of people in the community at early stages. The usual model of small number of adopters followed by the majority later may not be effective; a 'big push' of innovation may be required to break a sort of low equilibrium trap created by the fear of sabotaging activities. Obviously further research is needed.

NOTES

1. In the same spirit, the book by Bowles and Herbert (2011) is titled 'A cooperative species' and focuses on pro-social behavior.

2. We are grateful to one of the reviewers for suggesting these references.

3. Birr is the national currency of Ethiopia. At the time of the games, US$1 was worth around Birr 8.

4. This random dictator design follows Zizzo (2003). Note that, if the money burning decisions of all the participants are implemented, potentially the money to be burnt could be more than the money given to players.

5. The scripts of instructions for the variable and fixed groups are provided in an Online Appendix.

6. For the Bolton and Ockenfels (2000) model it does not matter how the money burning is spread across the other players *as long as* the ratio is improved toward the average payoff of the other players. This is why, by having both a subject-specific payoff difference and a ratio variable based on the average payoff of the other players as independent variables in a regression analysis, we will be able to respectively identify a Fehr and Schmidt (1999) or a Bolton and Ockenfels (2000) model effect.

7. The logic for making a distinction between safe and lottery winnings is based on the fact that safe money is kept without any risk but lottery money is earned after going for a risky undertaking.

8. Here and below in this section, we consider our tests at the level of independent observations: this means the session in the case of variable groups, and the group in the case of fixed groups. For example, in this Mann–Whitney test, $n = 10$ for the fixed groups and $n = 2$ for the variable group sessions. The regression analysis will employ the data more efficiently while controlling for the potential non independence of observations. *P* values in this paper are two-sided throughout.

9. To assess whether the income of the money burner would be significant in the absence of multicollinearity, we did the following. The variance inflation factor (VIF) for total income of the money burner in the regression reported in column (4) is 4.45; the square root of the VIF (2.11) indicates by how much the standard error is inflated due to multicollinearity. If the standard error of the coefficient is divided by the square root of the VIF, we get 0.0005 which is an estimation of what would be the standard error if there was no multicollinearity. With this standard error the income of the money burner would have become significant. This is additional evidence reinforcing our claim that the income ratio is partly capturing an income effect.

10. The ERHS is a panel household survey which has been conducted in 15 rural villages starting from 1994 in all important agro-ecological regions of the country. This paper uses the data from the round conducted in 2004; previous rounds were run in 1994, 1995, 1997, and 1999.

11. Here we are focusing on social preferences measured from our experimental games but are not discounting the very wide literature on agricultural innovations.

12. It is possible that innovation may simply be discouraged by the underlying inequality aversion but it is also possible that the burning specifically of money obtained after going for a risky undertaking may be a better proxy for the discouragement of real-world innovations. Because of this we distinguish between money burning rate out of safe money and money burning out of lottery winnings.

13. *Chat* (*Catha edulis*) is a mildly intoxicating plant that is consumed widely both in Ethiopia as well as neighboring countries. It has become an important source of income for farmers as well as a major foreign exchange earner for the country.

14. Obviously, this innovation index is a very rough measure. Among its other limitations, it does not take into account substitutability and complementarity between the different innovations.

15. In Imdibir, one of the study villages, a man is reported to have set fire to his brother's farm when his brother started cultivating a more profitable cereal.

16. *Enset* (*Ensete ventricosum*) is the false banana tree and is used as staple food among many ethnic groups in southern Ethiopia.

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APPENDIX A. DATA COLLECTION AND SURVEY SITES

The key data for this research are gathered from four villages. The villages were covered in a previous panel household survey which provides detailed data going as far back as 1994. One of the villages, Imdibir, is located southwest of the capital Addis Ababa in the Gurage region, a region in the heartland of a farming system based on *enset*[16] that is characterized by the use of the hoe rather than the ox-plough. The majority of the people are members of the Gurage, a highly entrepreneurial ethnic group active in commerce. The second, village Aze Deboa, is in the Kembata region, dominated by an ethnic group of the same name. Even though *enset* is important, cereals and other crops play a more prominent role compared to Imdibir. The third village, Terufe Kechema is near one of the biggest commercial centers in the south, the town of Shashemene. The region is dominated by the Oromo, the most populous ethnic group in Ethiopia. The fourth village, Yetmen, is located northwest of Addis Ababa and like most regions in the north farming is dominated by the cultivation of cereals and use of the ox plough. Yetmen and the surrounding area are well known for the production of *teff*, a type of cereal used for human consumption only in Ethiopia. The strong demand for *teff* has made the region relatively prosperous. As the short description above indicates, important ethnic and farming system differences are captured by these villages. Two of the most populous ethnic groups in Ethiopia – Oromo and Amhara – are the dominant ethnic groups in the two sites, Terufe Kechema and Yetmen, respectively. Similarly, the villages also capture important variations in agricultural systems: the ox-plough *versus* hoe-culture, *enset versus* cereals. The spread of agricultural innovations is also varied; for example, the percentages of farmers using fertilizer range from a low of 45% in Imdibir to a high of 97% in Yetmen.

Even though the main data came from the money burning experimental game, additional information was also gathered. Pre-game questionnaires capture background information on participants, agricultural practices, and innovations. Post-game questionnaires gathered information on the players' experience of the game. While the above-mentioned research instruments were administered on individuals participating in the game, additional information was also gathered through focus group discussions and sociological surveys. In each village, four focus groups – two with males and two with females – were organized. Four sociology lecturers from Addis Ababa University were commissioned to write sociological reports on each village using both gray literature and field visits where key informant interviews, local materials, folklores, anecdotal evidences, and similar information were gathered.

The rural fieldwork was conducted in February–March 2009. Due to low mobility/migration in rural Ethiopia, tracking households that were interviewed in the last round of the rural household survey in 2004 was not too difficult. While 60 individuals were required for the two sessions of the game in each village, the household survey covered more than that in each village. Some individuals (33 out of 240, i.e., 14%) did not turn up at the time of the game and had to be replaced by others not originally covered by the household survey.

The games were also played with 120 Addis Ababa University students in February 2010. The students were mainly at the undergraduate level and from the Education and Business and Economics faculties. While two sessions at Addis Ababa University are identical to the rural ones, two sessions with fixed groups of players were also conducted; this was done to examine the effect of playing with the same individuals in the three stages on money burning behavior as well as increase the number of independent observations and improve statistical power.

In three villages, halls that accommodate players sitting reasonably far apart were used; in the remaining one village the game was played in two big tents. In Addis Ababa, a very big hall that can accommodate a large number of people was used. Research assistants were intensively trained and one of the authors of this paper oversaw the conduct of all the experimental sessions.

In all cases, participants came to the designated place so that we had a more controlled environment compared to playing the games sequentially at different times and places like the homes of players. But significant differences with experimental game laboratories in Western universities should be noted. In the rural areas all individuals are drawn from the same village. Even though players could not identify who their group members are, each participant sees the remaining 29 players most or all of whom are likely to be known to him/her. Similarly, university students were drawn from a small number of faculties and hence are likely to know each other. This is different from complete anonymity in proper experimental labs where individuals interact through computer terminals. The lack of complete anonymity likely increases pro-social behavior, and so we believe the money burning rates are likely to be biased downward.

APPENDIX B. SUPPLEMENTARY DATA

Supplementary data associated with this article can be found, in the online version, at http://dx.doi.org/10.1016/j.worlddev.2014.10.022.

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