What affects smallholder farmers' willingness to cooperate? Evidence from public good games with different design elements in three African countries

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Abstract. Innovation adoption by small producers is key to promoting sustainable food systems in developing countries. However, some innovations require collective management and thus cooperation. Public Good Games (PGGs) are well-established settings to experimentally assess individuals' willingness to cooperate. We ran repeated (two-round) PGGs among smallholders in Tanzania, Kenya, and Tunisia. In Tanzania, we changed the multiplication factor and thus the return to the public good between rounds. In Kenya, we played one round with unequal and one with equal endowment, keeping the same total endowment at group level. We find that individual contributions do not vary significantly depending on the rate of return, unless smallholders face a lower rate in the second round, in which case the efficiency of cooperation declines. Opposite to our hypothesis, group-level contributions were higher with unequal endowment; however, less endowed players contributed less in both relative and absolute terms. We further control for group size, which does not seem to affect cooperation, and for round-order effects, finding that smallholders reduce their contributions if they have cooperated relatively more than their group members in the previous round. Our results can help derive recommendations for the successful dissemination of collaborative innovations.

Keywords: Public Good Game; smallholder farmers; Africa; endowment inequality; rate of return.

JEL Codes: C71; C93; D91; Q12

1. Introduction

In low-income countries, the adoption of innovation is key to improving farm performance and building sustainable food systems that increase food security. However, innovation adoption is not a linear process, and is affected by complex and interrelated factors pertaining to the individual farmer (socio-demographic and behavioural), the farm, the social, ecological and institutional context, and the characteristics of the innovation itself (profitability, risk, etc.) (Mills et al., 2017; Meda et al., 2018; Michler et al., 2019; Obiero et al., 2019; Mwololo et al., 2020). If an innovation requires or benefits from collective management, then social mechanisms like reputation, sanctions, the local culture (Turyahikayo et al., 2019), and thus the ability to achieve sustainable cooperation, are particularly relevant (Archambault et al., 2020).

Cooperation implies the payment of a cost for the benefit of others (Nowak, 2006). On the one hand, it creates the conditions for successful implementation of innovations; on the other hand, innovation implementation fosters cooperation, generating positive feedback loops. This is also the case of agricultural innovations, whose high investment costs and uncertain returns render the cooperation cost more acceptable to potential adopters, and cooperation a privileged approach for their diffusion, especially in low-income countries (Gómez et al., 2023). Cooperation is also a suitable approach for the adoption of innovations delivering benefits to the environment or the wider population that prevail over the cooperation cost (Archambault et al., 2020). Although the characteristics of some technological innovations contribute to solving the competition between selfish and other-regarding preferences, cooperation can also take place regardless the context, meaning that altruistic behaviours adopted in a specific domain are likely to be replicated in other circumstances (Peysakhovich et al., 2014). Thus, local institutions promoting social interrelations and collective action (e.g., sharing knowledge and facilities, contract farming) can build cooperative patterns and individuals' reputations that foster innovation adoption further (Santos et al., 2008; Andersson et al., 2011; Aydoğan et al., 2022; Ayamga et al., 2023).

Starting from the above premises, we investigate what affects the willingness to cooperate of smallholders from different African countries by testing treatments pertaining to the design of Public Good Games (PGG) (Andreoni, 1988). First implemented by Dawes et al. (1977), PGGs are a well-established typology of economic experiments used to elicit participants' willingness to cooperate or, equally, care for public good. Despite huge variation in design and implementing conditions, in general they are characterised by a dilemma between individual reward and generation of a public good that benefits everyone in the same measure. If the decision is repeated and participants are informed about the decisions of their peers in previous rounds, PGGs can also inform about the evolution of cooperation, and if this is sustainable. Our focus will be on the return to the public good and the initial resource distribution, but we will also control for round-order effects and group size.

The results of our study are relevant with respect to innovations requiring collaborative setup or management, and may inform policymakers and practitioners of drivers and barriers to their implementation. In particular, smallholders' reaction to different rates of return inform us about potential real-life reactions to lower-than-expected (or decreasing) gains; their reaction to inequality of endowment, on whether cooperation might be undermined by involving farmers with diverse wealth levels, despite richer farmers being better placed to become early adopters. The evolution of cooperation allows us to understand if farmers adopt 'compensating' behaviours, contributing less if they have received much, and vice versa, or cooperation is self-reinforcing, and thus sustainable. Finally, the impact of group size informs us of whether cooperation could be achieved more efficiently in large or small groups.

The rest of the article is structured as follows. Section 2 presents the theoretical background and derives our research hypotheses. Section 3 describes the case study regions, the data collection process, experimental interventions, and empirical approach. Section 4 presents and discusses the results. Finally, Section 5 concludes and derives recommendations.

2. Theoretical background and research hypotheses

In a standard PGG, a group of n participants are provided with an endowment e and must decide how much to keep for themselves, and how much to contribute to a common pool representing the public good. The share of endowment kept contributes directly to their individual payoff, while the resources in the common pool are multiplied by a factor $m > 1$ (the return to the public good) and equally distributed among the participants regardless of their contributions, thus replicating the non-excludable nature of public goods. The payoff of an individual participant i, with $j = 1, \dots, i, \dots, n$, is the following (Ostrom, 2000):

$$P_i = (e_i - c_i) + m\frac{\sum_{j=1}^{n} c_j}{n}, \qquad (1)$$

where c_i is i's individual contribution to the public good, i.e., their decision variable, measuring their willingness to cooperate. In our baseline setting, $e_i = 150\ \forall i$, $m = 2$,[1] and $n = 10$.

Under standard economic assumptions, players maximise their payoff by setting $c_i = 0$, and expect everyone else to do the same, thus no public good is generated. However, everyday life experience show that individuals deviate from these assumptions (Ostrom, 2000), since they are also driven by non-selfish preferences (altruism, fairness concerns, etc.). Thus, players' expectations about the total contribution of their peers, $\sum_{j \neq i} c_j$, might differ from zero. In repeated PGGs, expectations are updated after each round.

Abstracting from the different drivers of non-selfish preferences, we indicate with $a_i \geq 0$ and $s_i \geq 0$ $(a_i + s_i = 1)$, i's relative care for the public good received by a generic other player and for their own reward, respectively, and write the following Cobb-Douglas utility function:

$$U_i = \left(e_i - c_i + \frac{m\sum_{j=1}^{n} c_j}{n}\right)^{s_i} \left(\frac{m\sum_{j=1}^{n} c_j}{n}\right)^{a_i} \qquad (2)$$

Gauriot et al. (2020) show that restrictions on the curvature of the utility function can have significant implications for the estimation of a_i and s_i. However, we use a Cobb-Douglas function because of its desirable mathematical properties, primarily continuous differentiability (Brown, 2008). By splitting the return to the public good between the return to i's own contribution, $\frac{m}{n}c_i$, and the gain from other players' contributions $\frac{m}{n}\sum_{j \neq i} c_j$, replacing $\sum_{j \neq i} c_j = \bar{c}$, and taking the logarithm, we obtain:

$$U_i = s_i \log\left(e_i + \frac{m-n}{n}c_i + \frac{m}{n}\bar{c}\right) + a_i \log\left(\frac{m}{n}c_i + \frac{m}{n}\bar{c}\right) \qquad (3)$$

To obtain the value of the individual contribution c_i which maximises i's utility, we take the first derivative of (3) w.r.t. c_i, equate it to zero, and solve w.r.t. c_i:

$$\frac{dU_i}{dc_i} = \frac{(n-m)s_i}{n(c_i - e_i) - m(c_i + \bar{c})} + \frac{a_i}{c_i + \bar{c}} \qquad (4)$$

$$c_i^* = -\frac{(\bar{c}n - \bar{c}m)s_i - a_i e_i n - a_i \bar{c} m}{(n-m)s_i + a_i n - a_i m} \qquad (5)$$

[1] The Marginal Per Capita Return (MPCR) to the public good, m/n, is 0.2.

By differentiating (5) w.r.t. the single parameters, i.e., multiplication factor m, individual endowment e_i, group size n, and expectation about other players' total contribution $\bar{c}$, we can assess the direction of their relationship with c_i^* (the value of c_i that maximises utility).

$$\frac{dc_i^*}{dm} = \frac{a_i(e_i+\bar{c})n}{(s_i+a_i)(m-n)^2} \qquad (6)$$

The derivative of c_i^* w.r.t. m, shown in (6), is always positive; therefore, the contribution maximising utility is increasing in m. We derive the following hypothesis:

H1: *Ceteris paribus, smallholders contribute more to the public good when the multiplication factor is higher, and vice versa.*

To test this hypothesis, in Tanzania we vary the multiplication factor, and thus the rate of return to the public good, between rounds. Most literature on the rate of return explores the impact of uncertainty in this parameter (e.g., Freundt & Lange, 2021; Aksoy & Krasteva, 2020). Experimental evidence suggests that a higher MPCR results in larger public good contributions (Bruttel & Friehe, 2014; Isaac & Walker, 1988; Isaac et al., 1984; Kim & Walker, 1984).

Differentiating c_i^* w.r.t. e_i, we obtain:

$$\frac{dc_i^*}{de_i} = \frac{a_i n}{(n-m)(s_i+a_i)} \qquad (7)$$

The derivative is again always positive, suggesting that c_i^* is increasing in e_i, and we can affirm:

H2.1: *Ceteris paribus, smallholders with lower endowment contribute less to public good compared to smallholders with higher endowment, and vice versa.*

We test this hypothesis in Kenya by varying the endowment distribution between rounds: in the first round, $e_i = 100$ for half of each group and $e_i = 200$ for the other half, while in the second round, $e_i = 150\ \forall i$.[2] These values ensure that the group-level endowment is the same in both rounds, allowing us to make additional considerations.

Whether the group-level contribution is the same in the cases of equal and unequal endowment, depends on how the values of s_i, a_i, and $\bar{c}$ are distributed (n, m and e do not vary). If we assume that their joint distribution is similar between players with low and high endowment and between rounds, then the total group contribution that maximises individual utility is the same regardless of endowment inequality. However, for sufficiently high levels of s_i and sufficiently high levels of $\bar{c}$, the players with low endowment and those in the groups with equal endowment will find themselves in a situation where $c_i^* = 0$, while for those with high endowment is still $c_i^* > 0$. Therefore, the number of players who maximise their utility by contributing $c_i^* > 0$ is larger with unequal endowment. All considered, we can hypothesise the following:

H2.2: *With endowment inequality, group-level contributions to the public good are larger*.

Most of the literature that studies inequality through PGGs includes more than two endowment levels, and combines this aspect with other treatments, e.g., voting on a redistribution rule (Colasante & Russo, 2017), or earning the endowment through individual effort (Bjorvatn & Coniglio, 2020). Our **H2.1** aligns with Bjorvatn and Coniglio (2020), Cao et al. (2015), and Martinangeli (2021): generally, individuals penalised by inequality are less trustworthy, and perceive social relations as more competitive; moreover, inequality is linked with lower engagement in communal behaviours (Uslaner & Brown, 2005). Instead, **H2.2** deviates from the results of most

[2] While the order of the treatments was meant to be randomised, the enumerators in the field did not act accordingly. Thus, the effect of inequality cannot be disentangled from round-order effects.

economic experiments conducted in the Global North or China, namely Bjorvatn and Coniglio (2020), Colasante and Russo (2017), Paetzel and Traub (2017), Filippin and Raimondi (2016), Cao et al. (2015), and Cherry et al. (2005), who all argue that inequality reduces cooperation. Only Gueye et al. (2020) find, instead, that cooperation is more likely in the presence of inequality. However, they consider inequality in the payoffs rather than the endowment, and use an experimental design whereby the group-level payoff is larger with higher inequality. Because African societies are more collectivist than their Western counterparts (Green et al., 2005), we may find that smallholders contribute more to the public good in the presence of inequality.

According to Fischbacher et al. (2001), people differ in their cooperation preferences, and most of them are 'conditional co-operators', i.e., they only cooperate if others do. Our players have no prior information about others' decisions apart from their expectations, but after the first round, they receive a share of the public good that informs them of the total contribution of their peers, $\bar{c}$. We assume that they update their expectations accordingly, and their expectations enter the utility function. By differentiating c_i^* w.r.t. $\bar{c}$, we obtain:

$$\frac{dc_i^*}{d\bar{c}} = -\frac{(n-m)s_i - a_i m}{(n-m)(s_i + a_i)} \qquad (8)$$

The sign of the derivative depends on the relative sizes of s_i and a_i, and is positive if $s_i < m/n$, i.e., if non-selfish motivations weigh relatively more on the player's utility. However, the relative size of s_i and a_i are unknown before running the PGG. The bulk of literature focuses on the evolution of group-level contributions, and there is a consensus that 'payoff efficiency,' i.e., the mean payoff of a group normalised to range between 0 and 1 (Feltovich & Grossman, 2015), tends to decline over rounds (e.g., Bruttel & Friehe, 2014; Greiff & Paetzel, 2016; Bigoni & Suetens, 2012). Furthermore, Bigoni and Suetens (2012), who provide players with feedback about individual contributions, observe that players with higher propensity to cooperate tend to imitate the largest contributors. Such results are based on several rounds, while we only implemented two; nevertheless, our data allow us to test the following:

H3: *In subsequent PGG rounds, the smallholders whose group members have contributed more relatively to oneself increase their contribution, and vice versa*.

Due to no-shows and to differences in the catchment areas of the villages where the experiments were run, the size of the groups varies randomly. While there is consensus in the literature that group size affects cooperation, there is no consensus on the direction of the effect. Some studies (e.g., Feltovich & Grossman, 2015; Isaac & Walker, 1998) found that it is more difficult for large groups to cooperate efficiently. The social psychology literature also argues that, as group size increases, temptations to free ride also increase (Stroebe & Frey, 1982). Other studies (e.g., Pereda et al., 2019; Diederich et al., 2016; Isaac et al., 1994) conclude the opposite: larger groups are more efficient in achieving cooperation. Weimann et al. (2019) detect almost no effect, while Capraro and Bercelo (2015) identify a curvilinear effect: cooperation improves up to a certain size then declines. Given such contradictory results, we derive our last hypothesis by differentiating c_i^* w.r.t. n:

$$\frac{dc_i^*}{dn} = -\frac{a_i(e_i + \bar{c})m}{(s_i + a_i)(n-m)^2} \qquad (9)$$

This derivative is always negative, though the slope decreases for larger n, suggesting that:

H4: *Ceteris paribus, a larger group size results in smaller individual contributions*.

The above overview suggests that there is a large amount of literature on PGGs, but most studies rely on samples from Western countries or China, which usually consist of university students or WEIRD (White, Educated, Industrialized, Rich, Democratic) subjects. These findings cannot necessarily extend to African smallholders. While the impact of different rates of return does not seem to have been systematically researched in our countries of interest, at least one study used lab-in-the-field experiments to investigate the perceived fairness of different ways of distributing PES for forest conservation (Cook et al., 2023). Generally, the use of framing and the diversity of topics covered make the findings highly context-dependent, limiting comparability and potentially reproducibility. Instead, our field experiment aims to elicit underlying behavioural traits that are domain-general and temporally stable (Peysakhovich et al., 2014).

3. Material and methods

3.1. Data and data collection

Our data were collected in rural regions of Kenya, Tanzania and Tunisia in the framework of the EU project H2020 FoodLAND ("Food and Local, Agricultural and Nutritional Diversity"). The project involved five countries (the three above, plus Morocco and Uganda) and 12 rural regions therein; however, experimental activities were only conducted in one region per country, and the data from Morocco and Uganda are not used in this article. The rural regions were purposively selected by local project partners based on local agricultural productions, and their suitability for the demonstration of the innovations developed within the project. Many of these innovations require collective management via farmers' associations or cooperatives, with the processing equipment being installed at community level or within the premises of such organisations. These include, for instance, mobile applications for precision irrigation, which require a subset of local farmers to install sensors in their fields for monitoring various indicators.

In each region, the project established so called 'Food Hubs,' where smallholder farmers and other value chain stakeholders (e.g., processors, associations, NGOs, etc.) would work together to create conditions favourable to innovation adoption. As mentioned above, each Food Hub had different geographical characteristics. In Kenya, it includes several villages of the Mukurweini district, Nyeri county, located in the centre of the country. The average farm size is 0.75 hectares and the crops grown include cereals, pulses, roots, industrial crops (coffee), and horticultural crops. In Tanzania, the Food Hub encompasses the village of Ndole and nearby villages of the Mvomero district, in the northern parts of the Morogoro region. The average farm size is 3.1 hectares, and the main crops grown are rice, maize, beans, banana, cassava and sorghum. Finally, in Tunisia the region consists of various villages in the Fernana delegation, Jendouba governorate, a rural area in the northeast of the country with limited infrastructures and high unemployment and illiteracy. Here, agriculture is very diversified, and mainly focused on cereals, livestock, fodder and market gardening, with average farm size of 6.9 hectares.

As a preliminary step in the project, we ran surveys and economic experiments with local smallholders to detect socio-demographic, economic and behavioural characteristics potentially linked with their willingness to uptake innovation. Our goal was not to gather a representative sample of each country's farming population but rather of farmers in each of the Food Hub areas, and our data cannot be used to make inference on the national farming population.

In Kenya and Tunisia, we adopted a two-stage sampling strategy, randomly selecting villages within the Food Hub boundaries first, and then the farmers therein, while in Tanzania the first stage was not necessary. We obtained lists of farming households operating in the selected villages from local administrations or farmers' associations, and allocated them to a stratum based on age, gender, and farm size. If one gender represented less than 33% of the farming population, the underrepresented gender (generally women) was oversampled to obtain gender-specific insights, in line with funding requirements. Within each stratum, farmers were randomly sampled and invited to the venue where the activities were planned.

We call an event where several smallholders implemented the activities simultaneously a 'session.' Each session included at least 20 smallholders to allow for creation of two or more groups for the PGG, and lasted about three hours.[3]

Data collection took place between March and July 2021. The final sample size is 504 in Kenya, 482 in Tanzania, and 500 in Tunisia, totalling 1,486 observations, as shown in Table 1.[4]

Although data collection took place amid the Covid-19 pandemic, according to the local teams these had no significant impact on the quality of the data collection process. Depending on the country, either there was no lockdown in place (Tanzania), or the fieldwork took place as soon as the restrictions were eased (Tunisia). Measures to prevent the spread of the disease were adopted and generally, farmers were comfortable taking part and were not worried about infection, also due to the lower awareness and sensitivity to Covid-19 in rural areas.

3.2. Survey instruments and experimental protocols

In all countries, we used standardised survey questionnaires and experimental protocols (instructions). The questionnaire included 36 questions, mostly closed-ended, on farm production, willingness to uptake innovations, behavioural preferences, past setbacks, and future worries. The lab-in-the-field experimental sessions consisted of three behavioural games aimed at eliciting behavioural traits potentially related to innovation adoption: (i) a two-round PGG; (ii) a game to elicit risk attitudes; and (iii) a game to elicit time preferences. Only the PGG instructions varied between countries, because of the inclusion of different treatments, while the other tasks followed exactly the same protocol.[5] The questionnaire and the experimental protocols were drafted in English, translated into local languages, and back-translated. The protocols were pilot tested with students from local universities and farmers involving prospective enumerators, who also received training.

On the day of fieldwork, farmers were divided into groups for the PGG (at least two per session, with membership not revealed). The lead enumerator introduced the purpose of the exercise and gave a chance for the participants to ask questions, before obtaining explicit consent. Since we expected a large share of participants to be illiterate or with very low level of education, everyone received one-to-one support from local enumerators during the entire session, and every game was demonstrated beforehand. In Kenya and Tunisia, the responses were collected using pen and paper, while in Tanzania they were registered on tablets.

The order in which the questionnaire and the experimental session were administered could be swapped between sessions for logistical reasons, while the order of the games was always the same within the experimental session. The farmers received a show up fee, and a payoff whose amount depended on the results of the games. During the sessions, the payoffs were expressed in tokens; at the end of the entire session, these were converted into local currency at a rate that ensured the same average payoff at purchasing power parity across countries.

Using the taxonomy proposed by Harrison and List (2004), our games can be categorised as 'artefactual field experiments', since we used a conventional protocol with a non-standard pool of subjects. Although the rules of the games were described using tokens and without a framing related to daily farm activities, at the end of the instructions, smallholders were provided with

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[3] In Kenya two or more groups took part in the experiments at the same time, followed by other groups, and the day was recorded as a session; hence, not all farmers in a session were simultaneously present.
[4] The dataset used for the analysis is available at this link: [*omitted for review*] [retrieved 10 January 2023].
[5] The full experimental protocol is available at this link: https://doi.org/10.5281/zenodo.6341926 [retrieved 22 December 2023].

examples to contextualise the dilemma they were facing: in the case of the PGG, being a member of a producers association that aims to gather funds for supporting its members, or for implementing a development project in the village.

The two-round PGG used a simple payoff function, as presented in Eq. (1) in Section 2. In the baseline setting, farmers were divided into groups of 10, awarded an endowment of 150 tokens, and the total contributions to the public good were doubled before being shared. The impact of a lower multiplication factor and of endowment inequality were tested through within-subject treatments. Therefore, some of the parameters changed in one of the two rounds depending on the treatment, and in line with the hypotheses being tested, as specified in Table 1. In Tanzania, the multiplication factor was set at either $m = 2$ or $m = 1.5$, corresponding to MPCRs of 0.2 and 0.15, respectively; and their order was randomised between groups. As pointed out by Bruttel and Friehe (2014), 2 is relatively high compared to the standard levels of m, while 1.5 is in line with the average; but due to the large group size, the MPCRs are relatively low.

As described in Section 2, Kenyan smallholders faced inequality in one round only but the order of the treatments was not randomised. The group size was not varied systematically, and ranges between 4 and 21 smallholders.[6]

Farmers received their tokens in the form of fake currency, and their contributions to the public good were collected using envelopes to ensure confidentiality. After the first round, they were collectively informed about the share of public good they had received, while individual contributions were kept confidential.

Table 1. Parameters adopted in the PGG implementation, by country and overall.

Variables	Kenya	Tanzania	Tunisia	All countries
Individuals	504	482	500	1,486
Groups	49	48	50	147
Sessions	5	24	24	53
$e_{i,1}$	[100; 200]	150	150	[100; 150; 200]
m_1	2	[1.5; 2]	2	[1.5; 2]
$e_{i,2}$	150	150	150	150
m_2	2	[1.5; 2]	2	[1.5; 2]
n	[4; …; 21]	10	[9; 10; 11]	[4; …; 21]

Notes: For the meaning of the symbols, see the Section 2. The numbers in the subscript indicate the round.

3.3. Empirical strategy

In our analysis, we use different samples: country-specific, cross-country and, for each of them, individual and group-level observations. By pooling together the data, especially those from Tunisia, where the two rounds were run using the same incentive structure and feedback was provided after the first round, we mimic a difference-in-differences approach (Abadie, 2005). Furthermore, when relevant, we rely on the pooled panel datasets, which include two observations per individual or per group (one per round). All sample sizes are reported in Table 1.

Our variables of interest are the individual contributions c_i, their change between rounds Δc_i, group-level contributions c_k, with k indicating the group, and their change between rounds Δc_k. Our empirical strategy consists of two steps: (i) running t-tests of difference across treatments, rounds, and countries; (ii) running series of regression models controlling for other elements

[6] In Kenya, 62% of the smallholders (31 groups) played in groups of 8 to 12 members; in Tanzania, group size varied between 9 and 11, being 10 for 87% of the players (42 groups); in Tunisia, group size was always 10.

that may affect contributions. In particular, we assume individual and group-level contributions to be affected by: (a) PGG design element; (b) situational factors; and (c) individual smallholders' characteristics. Thus, we derive the following empirical equations:

$$c_{i,k,t,\upsilon,\mu} = \boldsymbol{\beta_L} L_{k,t,\upsilon,\mu} * t + \beta_e e_{i,k,t,\upsilon,\mu} + \beta_I I_{k,t,\upsilon,\mu} + \beta_k w_{i,k,t,\upsilon,\mu} + \beta_n n_{k,\upsilon,\mu} + \boldsymbol{Z_{i,k,\upsilon,\mu}\beta_Z} + \omega_\mu + \sigma_{\upsilon,\mu} + \gamma_\mu + \varepsilon_{k,\upsilon,\mu} \text{ for individual contributions;} \quad (10)$$

$$\Delta c_{i,k,\upsilon,\mu} = \boldsymbol{\beta_L} L_{k,\upsilon,\mu} + \beta_e e_{i,k,t-1,\upsilon,\mu} + \beta_I I_{k,t-1,\upsilon,\mu} + \beta_k w_{i,k,\upsilon,\mu} + \beta_n n_{k,\upsilon,\mu} + \boldsymbol{Z_{i,k,\upsilon,\mu}\beta_Z} + \sigma_{\upsilon,\mu} + \gamma_\mu + \varepsilon_{k,\upsilon,\mu} \text{ for change in individual contributions;} \quad (11)$$

$$c_{k,t,\upsilon,\mu} = \boldsymbol{\beta_L} L_{k,t,\upsilon,\mu} * t + \beta_I I_{k,t,\upsilon,\mu} + \beta_k w_{k,t,\upsilon,\mu} + \beta_n n_{k,\upsilon,\mu} + \overline{\boldsymbol{Z_{k,\upsilon,\mu}}}\boldsymbol{\beta_Z} + \gamma_\mu + \varepsilon_{k,\upsilon,\mu} \text{ for group-level contributions;} \quad (12)$$

$$\Delta c_{k,\upsilon,\mu} = \boldsymbol{\beta_L} L_{k,\upsilon,\mu} + \beta_I I_{k,t-1,\upsilon,\mu} + \beta_k w_{k,\upsilon,\mu} + \beta_n n_{k,\upsilon,\mu} + \overline{\boldsymbol{Z_{k,\upsilon,\mu}}}\boldsymbol{\beta_Z} + \gamma_\mu + \varepsilon_{k,\upsilon,\mu} \text{ for change in group-level contributions.} \quad (13)$$

Where k represents the group, t the round, υ the session, μ the country. L is a dummy for rounds with lower multiplication factor (interacted with the round when relevant); I is a dummy for the rounds with inequality; $\boldsymbol{Z}$ is a vector of individual, round-invariant characteristics; ω represents the enumerator-fixed effects; σ the session-fixed effects; and γ the country-fixed effects. w synthesises what happened in the previous round: in individual-level models, we use the ratio between one's contribution and the average group contribution, $n\frac{c_{i,t-1}}{\sum_{j\in k} c_{j,t-1}}$, in group-level models, the 'payoff efficiency' (Feltovich & Grossman, 2015), calculated as total group contribution relative to total group endowment, $\frac{\sum_{j\in k} c_j}{\sum_{j\in k} e_j}$.[7] The β's are the coefficients to be estimated, the ε are standard errors which, in line with most of the literature (e.g., Hambulo et al., 2020; Bchir, 2014; Gätcher & Herrmann, 2011), are clustered at group level.

For each model, we test different specifications of the dependent variables. For individual-level models, we use absolute contributions (c_i), and their value relative to the endowment (c_i/e_i). Apart from Kenya and the pooled sample, the two specifications are equivalent net of a scale effect. In the models for the change in individual contributions, we consider both absolute ($c_{i,2} - c_{i,1}$) and relative change ($\frac{c_{i,2}-c_{i,1}}{e_{i,1}}$).[8] Again, these specifications are equivalent for Tanzania and Tunisia, net of a scale effect. For group-level models, we use as dependent variables both the average contribution per participant, $\frac{\sum_{j\in k} c_j}{n}$, and 'payoff efficiency' (total group contribution relative to total group endowment). The models for the change in group-level contributions use the difference in these variables between rounds. Both pairs of group-level specifications are equivalent in all the countries net of a scale effect.

As for situational factors, session-fixed effects represent a proxy for the enumerators, weather conditions, the share of participants 'known' by oneself, and other time- and location-specific occurrences. The identity of the enumerators providing support is available for Kenya; the share of participants known is available for Tanzania and Tunisia.

The individual controls are age, gender, level of education, income, beliefs about other farmers' trustfulness and fairness, risk and time preferences, and entrepreneurship. For income, we

[7] To avoid losing the observations, this variable is assigned value 1 for individual-level models, implying a baseline expectation that other farmers will donate as much as oneself; and 0 for group-level models.
[8] Our variable represents rather the change relative to the individual endowment. When the endowment varies between rounds, relative change is calculated as $\Delta c_i = c_2/e_2 - c_1/e_1$.

include two proxies: the share spent on food (five levels), and self-assessed food security (dummies).[9] The beliefs about other farmers' trustfulness and fairness were measured using five-level Likert scales, and then turned into dummies; risk and time preferences were elicited via the experiments. As a proxy of the farmer's entrepreneurship, we use the share of farm product sold (in terms of value). In the models for group-level contributions, all these individual controls are included as averages for the group.

Each set of explanatory variables was preliminarily tested for collinearity. Some explanatory variables are omitted in specific models if they present this issue, do not vary within the sample, or are not available because of variations in the complementary questionnaires.

For both the country-specific and the cross-country samples, we estimate different model typologies: (i) OLS models for all dependent variables; (ii) Tobit models for the dependent variables which are censored; (iii) logistic models for the variables that vary between 0 and 1. For instance, we use Tobit models for absolute contributions (c_i and $\frac{\sum_{j \in k} c_j}{n}$), which present lower censoring at 0 and upper censoring at 150 (save individual contributions in Kenya, censored only at 0); for their change between rounds, censored at -150 and 150 (save individual contributions in Kenya, which have no univocal censoring value); for relative contributions ($\frac{c_{i,2} - c_{i,1}}{e_{i,1}}$ and $\frac{\sum_{j \in k} c_j}{\sum_{j \in k} e_j}$), always censored at 0 and 1; and for their change between rounds, censored at -1 and 1. We only estimated logit models for c_i/e_i and c_k/e_k. In all the specifications where the dependent variable is the contribution, not its change, we use the pooled panel dataset (two rounds) and besides typologies (i)-(iii), we also estimate (iv) random- and (v) fixed-effect panel models.

We assess the performance of different models using the same set of explanatory variables (OLS, Tobit, or logit) using the Bayesian Information Criterion (BIC; Schwarz, 1978) and the Akaike Information Criterion (AIC; Findley & Parzen, 1998). OLS performs better in all cases save the models for absolute individual contributions (c_i) and for their change between rounds ($c_{i,2} - c_{i,1}$) in Tanzania and Tunisia. Hence, they are reported in the tables in Section 4. When significant, the sign and relative size of the coefficients are coherent across models.

4. Results and discussion

In this section, we present and discuss our results, focusing on one hypothesis at a time.

4.1. Descriptive statistics

Overall, 1,486 smallholders took part in the PGG, divided into 147 groups. The statistics relative to the individual samples are in Table 2, while those for the group-level samples are in Table 12 in Annex. The group-level samples are obtained averaging individual-level variables by group; therefore, the mean values are very similar.

Both the dependent and the explanatory variables differ significantly between countries. First-round contributions are highest in Kenya, where half of the farmers were endowed 200 tokens; and lowest in Tanzania, where we also observe more variability. This ranking is preserved in the second round, when we see an increase in the absolute and relative contributions in all countries,

[9] Although our survey included questions about income levels, incomes tend to be underreported compared to consumption, which is generally preferred to calculate poverty headcounts (World Bank, 2020). Our approach is supported by Engel's law (Browning, 2008), a well-established empirical regularity.

although much larger in Tunisia. As shown in Table 12, group size does not differ significantly between countries.

Table 2. Descriptive statistics for the individual-level sample, by country and for all countries.

Variable	Kenya		Tanzania		Tunisia		All countries		Difference
	Mean	St. dev.	Mean	St. dev.	Mean	St. dev.	Mean	St. dev.	(*p*-value)[1]
Relative contribution (round 1)	0.482	0.228	0.386	0.347	0.423	0.291	0.431	0.295	0.000***
Contribution (round 1)	73.274	45.498	57.855	52.099	63.376	43.702	64.942	47.569	0.000***
Relative contribution (round 2)	0.502	0.213	0.402	0.352	0.488	0.306	0.465	0.298	0.000***
Contribution (round 2)	75.337	31.946	60.247	52.867	73.196	45.935	69.722	44.765	0.000***
Change in relative contribution	0.020	0.184	0.016	0.287	0.065	0.304	0.034	0.264	0.000***
Change in contribution	2.063	39.334	2.392	43.055	9.820	45.528	4.780	42.824	0.001***
Own / average contribution (round 1)	1.000	0.587	1.048	0.990	0.999	0.666	1.015	0.764	0.126
Group size	11.599	3.933	10.054	0.355	10.000	0.000	10.560	2.415	-
Age (years)	52.304	14.939	41.145	15.648	45.508	12.482	46.415	15.105	0.000***
Gender (female)	0.429	0.495	0.415	0.493	0.466	0.499	0.437	0.496	0.249
Education (1-5)	3.099	1.077	2.711	0.767	2.714	1.277	2.844	1.080	0.000***
Income spent on food (1-5)	2.538	1.446	2.979	1.288	3.334	1.224	2.949	1.363	0.000***
Difficult to meet food needs (dummy)	0.315	0.465	0.444	0.497	0.692	0.462	0.484	0.500	0.000***
Food needs fully met (dummy)	0.468	0.499	0.403	0.491	0.138	0.345	0.336	0.472	0.000***
Share of production sold (0-1)	0.557	0.347	0.378	0.320	0.332	0.333	0.423	0.347	0.000***
Trusting other farmers (dummy)	0.649	0.478	0.514	0.500	0.234	0.424	0.465	0.499	0.000***
Not trusting other farmers (dummy)	0.067	0.251	0.086	0.281	0.258	0.438	0.138	0.345	0.000***
Believe others are fair (dummy)	0.494	0.500	0.310	0.463	0.306	0.461	0.371	0.483	0.000***
Believe others are unfair (dummy)	0.143	0.350	0.149	0.356	0.274	0.446	0.189	0.392	0.000***
Risk aversion, experiments (0-10)	5.597	2.606	5.506	2.267	4.668	2.761	5.255	2.589	0.000***
Impatience, experiments (0-10)	3.040	3.456	2.649	3.724	3.010	3.199	2.903	3.465	0.000***
Share of participants known (0-1)	-	-	0.271	0.387	0.339	0.283	0.599	0.490	0.000***
Sample size (per round)	504		482		500		1,486		

Notes: [1] Kruskal-Wallis test of difference between countries (Fisher's exact test for binary variables). Group size is not tested here because it is constant for all smallholders within a group. Significance levels: *** p<0.01, ** p<0.05, * p<0.10.

In terms of socio-demographic characteristics, Kenyan smallholders are the oldest (52.3 years), Tanzanians the youngest (41.1). The gender distribution does not differ significantly between countries, with 43.7% of the overall participants being women. Education is higher in Kenya, where we also observe less poverty, opposite to Tunisia where 69.2% of the respondents had difficulties meeting their food needs. Kenya is also the country with the most entrepreneurial smallholders, with 55.7% of the production sold on average, compared to around one third elsewhere. The differences in terms of beliefs about the trustfulness and fairness of other farmers are also significant: Tunisia stands out for its negative feelings, and for the lower prevalence of positive feelings, especially trust; Kenya, for the large share of trustful farmers (64.9%). Our smallholders are on average more risk averse than a fully rational player (with Tunisians being slightly more risk-taking) and position themselves in the lower half of our impatience scale, with Tanzanians being the least impatient. Finally, participants knew on average a larger share of fellow smallholders in Tunisia compared to Tanzania.

4.2. Multiplication factor

The results of the *t*-tests related to **H1** are provided in Table 3 for the individual-level samples, and Table 4 for the group-level samples. The 1.5 multiplication factor is not associated to significantly different contributions in the pooled panel dataset or in the first round for Tanzania only. In turn, the smallholders who faced the lower multiplication factor in the second round contributed less compared to their counterparts, the difference being significant at 10% for both the individual- and group-level samples. If considering the cross-country dataset, contributions are significantly lower among those facing the 1.5 multiplication factor, and the gap becomes larger in the second round. Equally, the change in contributions between rounds, always positive, is significantly smaller among these smallholders. When controlling for individual characteristics and for other treatments, we observe, instead, significantly higher contributions if $m = 1.5$ in the second round in the Tanzanian sample, and in the first round in the cross-country sample, but only at individual level (Table 8). In turn, the lower multiplication factor is related to a significant decrease in contributions between rounds both in Tanzania and in the cross-country sample, but again, only at individual level (Table 9). The results concerning the cross-country sample must be considered with care given the lower level of contributions of Tanzanian smallholders, while the significance of group-level coefficients is impacted by the smaller sample size. Despite these caveats, which remain valid when other hypotheses are considered, we can affirm:

R1a: *Smallholders contribute less to the public good when facing a lower multiplication factor in the second round*; and

R1b: *Smallholders reduce their contributions when facing a lower multiplication factor in the second round.*

Such results are in line with Bruttel and Friehe (2014), who found that in repeated PGGs, players who have previously experienced high marginal returns contribute less once their return decreased. This suggests that if farmers' return to innovation declines compared to what they were used to or is lower compared to their expectations, cooperation might be negatively affected. In turn, differences in returns between projects taking place at the same time are unlikely to undermine cooperation in the less effective project.

Table 3. *T*-tests relative to **H1** (multiplication factor) on the individual-level samples for Tanzania and all countries.

Curren multi-plication fac-tor[1]	Tanzania								All countries											
	both rounds		first round		second round		change		both rounds		first round		second round		second round $		change		change $	
	c_i/e_i	c_i	c_{1i}/e_{1i}	c_{1i}	c_{2i}/e_{2i}	c_{2i}	$\Delta(c_i/e_i)$	Δc_i	c_i/e_i	c_i	c_{1i}/e_{1i}	c_{1i}	c_{2i}/e_{2i}	c_{2i}	c_{2i}/e_{2i}	c_{2i}	$\Delta(c_i/e_i)$	Δc_i	$\Delta(c_i/e_i)$	Δc_i
a) 2	0.399	59.87	0.375	56.24	0.423	63.49	0.027	4.02	0.459	69.09	0.438	66.00	0.481	72.18	0.495	74.27	0.040	5.56	0.043	5.93
b) 1.5	0.388	58.23	0.396	59.46	0.380	57.00	0.005	0.76	0.388	58.23	0.396	59.46	0.380	57.00	0.380	57.00	0.005	0.76	0.005	0.76
Pr(a<b)	0.685		0.249		0.911		0.797		1.000		0.976		1.000		1.000		0.968	0.944	0.979	0.955
Pr(a≠b)	0.629		0.498		0.178		0.406		**0.000*** **		**0.047** **		**0.000*** **		**0.000*** **		**0.064***	0.111	**0.042** **	**0.090***
Pr(a>b)[2]	0.315		0.751		**0.089***		0.203		**0.000*** **		**0.024** **		**0.000*** **		**0.000*** **		**0.032** **	**0.056***	**0.021** **	**0.045***

Notes: The sample size is 482 per round in Tanzania, of which 241 with multiplication factor 2, and 241 with multiplication factor 1.5. Across all countries, the sample with multiplication factor 2 is 2,490 across both rounds, and 1,245 in the second round (1,004 if the farmers who faced a multiplication factor of 1.5 in the first round are not included among those who are currently facing a multiplication of 2, marked $). Significance levels: *** p<0.01, ** p<0.05, * p<0.10. [1] This refers to the *current* multiplication factor; for instance, when only the second-round contributions or the changes between rounds are considered, they are allocated according to the multiplication factor in the second round being 2 or 1.5; when the pooled panel dataset is used, the observations are allocated based on the multiplication factor in the respective round. [2] This is the relevant probability given our H1.

Table 4. *T*-tests relative to **H1** (multiplication factor) on the group-level samples for Tanzania and all countries.

Current multiplica-tion factor[1]	Tanzania								All countries											
	both rounds		first round		second round		change		both rounds		first round		second round		second round $		change		change $	
	c_k/e_k	c_k	c_{1k}/e_{1k}	c_{1k}	c_{2k}/e_{2k}	c_{2k}	$\Delta(c_k/e_k)$	Δc_k	c_k/e_k	c_k	c_{1k}/e_{1k}	c_{1k}	c_{2k}/e_{2k}	c_{2k}	c_{2k}/e_{2k}	c_{2k}	$\Delta(c_k/e_k)$	Δc_k	$\Delta(c_k/e_k)$	Δc_k
a) 2	0.399	59.81	0.375	56.22	0.423	63.40	0.026	3.91	0.462	69.18	0.442	66.15	0.481	72.22	0.496	74.36	0.036	5.44	0.039	5.81
b) 1.5	0.388	58.25	0.397	59.49	0.380	57.02	0.005	0.79	0.388	58.25	0.397	59.49	0.380	57.02	0.380	57.02	0.005	0.79	0.005	0.79
Pr(a<b)	0.690		0.235		0.926		0.785		1.000	1.000	0.961	0.959	1.000		1.000		0.953		0.969	
Pr(a≠b)	0.620		0.471		0.147		0.430		**0.000*** **	**0.000*** **	**0.078***	**0.082***	**0.000*** **		**0.000*** **		**0.093***		**0.063***	
Pr(a>b)[2]	0.310		0.765		**0.074***		0.215		**0.000*** **	**0.000*** **	**0.039** **	**0.041** **	**0.000*** **		**0.000*** **		**0.047** **		**0.031** **	

Notes: The sample size is 48 per round in Tanzania, of which 24 with multiplication factor 2, and 24 with multiplication factor 1.5. Across all countries, the sample with multiplication factor 2 is 246 across both rounds, and 123 in the second round (99 if the farmers who faced a multiplication factor of 1.5 in the first round are not included among those who are currently facing a multiplication of 2, marked $). Significance levels: *** p<0.01, ** p<0.05, * p<0.10. [1] See note to Table 3. [2] This is the relevant probability given our H1.

Table 5. *T*-tests relative to **H2.1** (endowment inequality *between individuals*) on the individual level samples for Kenya and all countries.

Endowment (or previous endowment)[1]	Kenya						All countries											
	first round		second round		change		first round				second round				change			
	c_{1i}/e_{1i}	c_{1i}	c_{2i}/e_{2i}	c_{2i}	$\Delta(c_i/e_i)$	Δc_i	c_{1i}/e_{1i}		c_{1i}		c_{2i}/e_{2i}		c_{2i}		$\Delta(c_i/e_i)$		Δc_i	
a) 150							0.404	0.404	60.67	60.67	0.446	0.446	66.84	66.84	0.041	0.041	6.17	6.17
b) 100	0.461	46.06	0.494	74.07	0.033	28.01		0.461		46.06		0.494		74.07		0.033		28.01
c) 200	0.505	100.92	0.511	76.62	0.006	-24.30	0.505		100.92		0.511		76.62		0.006		-24.30	
Pr(diff<0)2	***0.015*** **	***0.000**** **	0.186	0.186	0.951	1.000	***0.000**** **	**0.004*** **	***0.000**** **	1.000	**0.002*** **	**0.014** **	**0.002*** **	**0.014** **	0.962	*0.658*	1.000	***0.000**** **
Pr(diff≠0)	**0.031** **	**0.000*** **	0.372	0.372	**0.099***	**0.000*** **	**0.000*** **	**0.009*** **	**0.000*** **	**0.000*** **	**0.003*** **	**0.027** **	**0.003*** **	**0.027** **	**0.075***	0.684	**0.000*** **	**0.000*** **
Pr(diff>0)	0.985	1.000	0.814	0.814	***0.049****	***0.000**** **	1.000	*0.996*	1.000	***0.000**** **	0.998	0.986	0.998	0.986	***0.038****	0.342	***0.000**** **	1.000

Notes: The sample size is 982 with an endowment (or previous endowment) of 150, 254 with an endowment (or previous endowment) of 100, and 250 with an endowment (or previous endowment) of 200. Significance levels: *** p<0.01, ** p<0.05, * p<0.10. [1] The second-round contributions and the changes in contributions between rounds are allocated based on the endowment received in the first round; in the cross-country sample, the pairwise comparison implies that for each dependent variable, either those who faced a previous endowment of 100 or 200 are excluded before running the *t*-test. [2] The relevant probabilities given our H2.1 are in *italics*.

Table 6. *T*-tests relative to **H2.2** (endowment inequality *per se*) on the individual- and group-level samples for Kenya and all countries.

Level of analysis	Endowment (or previous endowment)[1]	Kenya		All countries							
		both rounds		both rounds		first round		second round		change	
		c/e	c	c/e	c	c_1/e_1	c_1	c_2/e_2	c_2	$\Delta(c/e)$	Δc
Individual contributions	a) equal	0.502	75.34	0.441	66.12	0.404	60.67	0.446	66.84	0.041	6.17
	b) unequal	0.482	73.27	0.482	73.27	0.482	73.27	0.502	75.34	0.020	2.06
	Pr(a<b)[2]	0.923	0.798	**0.002*** **	**0.001*** **	**0.000*** **	**0.000*** **	**0.000*** **	**0.000*** **	0.930	0.960
	Pr(a≠b)	0.155	0.405	**0.004*** **	**0.002*** **	**0.000*** **	**0.000*** **	**0.001*** **	**0.001*** **	0.140	**0.080***
	Pr(a>b)	**0.077***	0.202	0.998	0.999	1.000	1.000	1.000	1.000	**0.070***	**0.040** **
Group contributions	a) equal	0.504	75.54	0.441	66.11	0.405	60.67	0.446	66.84	0.041	6.16
	b) unequal	0.494	73.83	0.494	73.83	0.494	73.83	0.504	75.54	0.011	1.71
	Pr(a<b)[2]	0.682	0.705	**0.002*** **	**0.003*** **	**0.000*** **		**0.004*** **		0.980	
	Pr(a≠b)	0.636	0.591	**0.005*** **	**0.006*** **	**0.000*** **		**0.007*** **		**0.040** **	
	Pr(a>b)	0.318	0.295	0.998	0.997	1.000		0.997		**0.020** **	

Notes: For individual contributions, the sample size with unequal endowment is always 504, with equal endowment is 504 in Kenya, 2,468 in all countries in both rounds, and 982 in all countries in the first round only. For group-level contributions, the sample size with unequal endowment is always 49, with equal endowment is 49 in Kenya, 245 across all countries in both rounds, and 98 across all countries in the first round only. Significance levels: *** $p<0.01$, ** $p<0.05$, * $p<0.10$. [1] See note to Table 5. 2 These are the relevant probabilities given our H2.2.

Table 7. Correlation coefficients related to **H3** (conditional cooperation), in the single countries and across all countries.

Countries	Individual-level sample		Group-level sample	
	c_{2i}/e_{2i}	$\Delta(c_i/e_i)$	c_{2k}/e_{2k}	$\Delta(c_k/e_k)$
Kenya	0.419	-0.403 / -0.719 [1]	0.845	-0.381
Pr(ρ≠0)	**0.000*** **	**0.000*** **	**0.000*** **	**0.007*** **
Tanzania	0.584	-0.321	0.612	-0.458
Pr(ρ≠0)	**0.000*** **	**0.000*** **	**0.000*** **	**0.000*** **
Tunisia	0.362	-0.500	0.792	0.051
Pr(ρ≠0)	**0.000*** **	**0.000*** **	**0.000*** **	0.724
All countries	0.472	-0.390 / -0.464 [5]	0.761	-0.240
Pr(ρ≠0)	**0.000*** **	**0.000*** **	**0.000*** **	**0.003*** **

Notes: [1] The second coefficient for the Kenyan and all-country samples refers to the change in absolute contributions, Δc_i; in the Tanzanian and Tunisian samples, the two coefficients coincide (equal endowment).
The above variables are correlated with w as defined in Section 3.3. In line with our H3, in the second and fourth columns (change) we should observe negative correlation values.
Significance levels: *** $p<0.01$, ** $p<0.05$, * $p<0.10$.

4.3. Inequality of endowment

The impact of endowment inequality is complex since there is an interplay between individual conditions, whose impact is considered in **H2.1**, and awareness of inequality *per se*, considered in **H2.2**; furthermore, inequality is collinear with round-order effects.

The results of t-tests on **H2.1** are provided in Table 5. In the Kenyan sample, we observe that the smallholders with lower endowment contribute significantly less in both absolute and relative terms. In the second round, they increase their contributions significantly more compared to those who faced a higher endowment, in relative and absolute terms. We observe no significant differences in the second round, between farmers who faced different endowment levels. Kenyan farmers contribute significantly more in relative terms than the farmers who were endowed 150 tokens in the first round, regardless of their endowment level, and this difference is preserved in the second round; only, the farmers endowed with 100 tokens contribute significantly less in absolute terms, as expected. The relative change between rounds is significantly smaller for the smallholders previously endowed with 200 tokens, and not significantly different for those with lower endowment. Such findings are confirmed if controlling for other variables: less endowed smallholders contribute less in absolute and relative terms (Table 8). Moreover, the change in their contributions between rounds is smaller in relative but larger in absolute terms, both in the Kenyan and cross-country samples (Table 9). Thus, our **H2.1** is verified:

R2.1: *With inequality, the smallholders with lower endowment contribute less to the public good compared to those with higher endowment, and vice versa, both in absolute and relative terms.*

Our result deviates from Martinangeli (2021), who registers higher contributions by the poor in the presence of inequality, or Bjorvatn and Coniglio (2020), who found no significant difference in individual contributions. Overall, the dynamics detected may suggest that in 'collectivist African societies' (Green et al., 2005), inequality is a driver of social support from rich farmers to poor ones. For instance, Cook et al. (2023) detected a preference for conservation payments being distributed equally by design, with a stronger effect among the participants who received a lower share of the payment.

Table 6 reports the results of the *t*-tests relative to **H2.2**. In the presence of inequality, individual contributions are significantly lower but only in relative terms and only at the 10%, while group contributions do not differ significantly. When considering the cross-country sample, we observe significantly higher contributions both in the round with inequality and in the following round, but this is likely driven by the specific behaviour of Kenyan smallholders. We also observe significantly smaller increase in contributions between rounds. These dynamics remain valid with absolute and relative contributions, and at individual and group levels. Controlling for individual characteristics and other treatments, however, we find that absolute contributions are significantly higher with inequality at individual (Table 8) and group levels (Table 10); relative contributions. only at group level but in both the Kenyan and cross-country samples. In turn, facing inequality is only associated with a decrease in absolute contributions at individual level (Table 9), a dynamic possibly driven by the farmers endowed with 200 tokens. Hence, **H2.2** is verified:

R2.2: *Ceteris paribus, with inequality group-level contributions to the public good are larger.*

This is in line with Gueye et al. (2020), who, using a within-subject design among the general French population, find that '*more inequality unambiguously yields a higher level of coordination success*' (p.26), but contradicts the bulk of the literature. However, differently from Gueye et al. (2020), we do not conclude that reduction in inequality facilitates coordination because the change in contributions after facing inequality is positive but smaller (when running *t*-tests), or non-significant (if controlling for other factors).

4.4. Evolution of cooperation

Table 2 and Table 12 in Annex show that the average contributions level increases between rounds in all samples; however, this change is significant only in Tunisia and in the cross-country sample. Furthermore, Table 7 reports correlation coefficients between contributions or their change, and the variable indicating group decisions in the previous round, w. The smallholders and groups cooperating more in the first round cooperate more in the second round too. This correlation is stronger in Tanzania at individual level, and in Kenya at group level. The correlation between w and second-round contributions is negative. Finally, the groups where first-round 'payoff efficiency' was lower achieve higher efficiency in the subsequent round, and vice versa. The models in Table 8 and Table 10 provide more nuance on the above findings. Indeed, in Tanzania at individual level and in all countries at group level, the round-order effects are negative, while the coefficients for w are positive, i.e., there is a baseline decline in cooperation but the relative rank of individuals and groups is preserved. The estimates in Table 10 and Table 11 confirm the results of the *t*-tests for the change in contributions. Therefore, **H3** is verified:

R3a: *In subsequent rounds, the smallholders whose groups have contributed more relatively to oneself increase their contribution, and vice versa*; and

R3b: *More cooperative smallholders keep being more cooperative, and vice versa.*

R3b is in line with Bigoni and Suetens (2012), among others. The negative round-order coefficient for groups confirms the finding that 'payoff efficiency' declines progressively (Bruttel & Friehe, 2014; Greiff & Paetzel, 2016; Bigoni & Suetens, 2012). While we ran only two rounds, our results suggest that ensuring the long-term sustainability of collective innovation projects in the presence of free riders could be challenging.

4.5. Group size effect

Since group size did not vary systematically, we do not include a table with *t*-tests; nevertheless, the correlation between the variables in Table 7 and group size is never significant, regardless of the sample. Equally, group size yields no significant coefficients when controlling for other variables, apart from being associated with a larger change in individual contributions in Tanzania, and smaller in Tunisia (where session size is used). Therefore, our **H4** is not verified:

R4: *Group size does not affect individual- and group-level contributions.*

This finding aligns with Pereda et al. (2019), Diederich et al. (2016), and Isaac et al. (1994), who all ran the experiments in the Global North. We could thus argue that achieving cooperation does not require small farmers' groups, and it is possible to involve groups of different sizes in cooperative projects without undermining their sustainability. Nevertheless, this must be considered carefully due to the limited and non-systematic variability of our parameter.

Table 8. Models for individual contributions (relative and absolute) in both rounds, in the single countries and across all countries.

Models for individual contributions in single rounds	Relative contribution (c_i/e_i)				Absolute contribution (c_i)			
	Kenya[1]	Tanzania[1]	Tunisia[1]	All countries[1]	Kenya[2]	Tanzania[3]	Tunisia[3]	All countries[2]
Round with lower return (dummy)		0.002		**0.050*** **		-1.087		**7.624*** **
Round with lower return # 2nd round		**0.100** **		-0.011		**19.534*** **		-1.813
Round with inequality (dummy)	-0.003			**0.040** **	**24.941*** **			**31.353*** **
Endowment of 100 (dummy)	**-0.034* **			**-0.040** **	**-53.680*** **			**-54.521*** **
2nd round (dummy)		**-0.045* **	**0.066*** **	**0.039*** **		**-8.367** **	**10.203*** **	**6.004*** **
Own / average contribution (round 1)	**0.135*** **	**0.211*** **	**0.155*** **	**0.186*** **	**20.502*** **	**36.845*** **	**26.346*** **	**28.132*** **
Group size (Session size in Tunisia)	-0.001	-0.055	0.007	-0.002	-0.175	-5.702	1.078	-0.251
Share of participants known (0-1)		0.058	**-0.078* **			9.584	**-14.525* **	
Age (years)	**-0.012*** **	**0.012*** **	0.002	0.002	**-1.847*** **	**2.110*** **	0.261	0.323
Age (years) (squared)	**0.000*** **	**0.000*** **	0.000	0.000	**0.016*** **	**-0.022*** **	0.002	-0.003
Gender (female)	-0.006	**-0.052** **	-0.049	**-0.031** **	-0.077	**-8.507** **	**-8.328* **	**-4.362** **
Education (1-5)	**-0.016** **	0.022	-0.008	-0.006	**-2.206** **	**3.869* **	-1.547	-0.846
Income spent on food (1-5)	-0.007	-0.004	-0.004	-0.006	-0.804	-0.802	-0.897	-0.712
Difficult to meet food needs (dummy)	0.001	-0.011	0.019	0.004	0.321	-3.872	3.617	0.922
Food needs fully met (dummy)	-0.007	-0.003	0.053	0.012	-1.567	-2.069	**8.777* **	1.764
Share of production sold (0-1)	0.027	0.021	-0.018	0.018	4.823	2.866	-2.578	2.634
Trusting other farmers (dummy)	-0.003	-0.023	0.012	-0.013	0.620	-3.695	3.542	-1.814
Not trusting other farmers (dummy)	**0.071** **	-0.011	0.007	0.012	**12.263** **	-1.907	0.939	2.042
Believe others are fair (dummy)	0.001	0.010	**0.037* **	0.015	-0.746	0.879	**7.139* **	2.119
Believe others are unfair (dummy)	0.019	-0.020	0.017	0.013	1.570	-5.366	2.762	1.715
Risk aversion, experiments (0-10)	-0.001	0.000	0.001	0.000	-0.089	-0.184	0.317	0.087
Impatience, experiments (0-10)	0.000	-0.002	-0.002	0.000	-0.121	-0.277	-0.429	0.012
Tanzania (dummy)				**-0.202*** **				**-29.859*** **
Constant term	**0.697*** **	0.446	0.080	**0.268*** **	**103.246*** **	34.476	10.725	**37.876*** **
Experimenter fixed effects	YES	NO	NO	NO	YES	NO	NO	NO
Session fixed effects	YES	YES	YES	YES	YES	YES	YES	YES
Sample size	1,008	954	1,000	2,962	1,008	954	1,000	2962
R-squared	0.151	0.241	0.207	0.201				
Log-likelihood	175.069	-218.544	-100.026	-270.322	-4.9e+03	-4.6e+03	-4.8e+03	-15,014.863
AIC	-282.138	523.087	282.053	688.643	9,849.391	9,253.022	9,594.094	30,179.73
BIC	-115.003	732.096	483.270	1,132.171	10,021.44	9,466.891	9,800.220	30,629.25
Power	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000

Notes: All the models were selected based on their AIC and BIC values: [1] OLS; [2] Left-censored (0) Tobit models; [3] Left-censored (0) and right-censored (150) Tobit models. Significance levels: *** *p*<0.01, ** *p*<0.05, * *p*<0.10.

Table 9. Models for change in individual contributions (relative and absolute) between rounds, in the single countries and across all countries.

Models for change in individual contributions between rounds	Relative contribution ($\Delta(c_i/e_i)$)				Absolute contribution (Δc_i)			
	Kenya[1]	Tanzania[1]	Tunisia[1]	All countries[1]	Kenya[1]	Tanzania[2]	Tunisia[2]	All countries[1]
Round with lower return (dummy)		**-0.070****		**-0.113*****		**-10.680*****		**-17.453*****
Previous round with inequality (dummy)				-0.016				**-26.989*****
Previous endowment of 100 (dummy)	**-0.105*****			**-0.080*****	**28.315*****			**35.663*****
Own / average contribution (round 1)	**-0.188*****	**-0.110*****	**-0.233*****	**-0.153*****	**-34.583*****	**-16.565*****	**-35.065*****	**-23.876*****
Group size (Session size in Tunisia)	0.004	**0.099***	**-0.011****	0.003	0.478	**14.821***	**-1.592****	0.324
Share of participants known (0-1)		0.043	-0.062			6.352	-9.490	
Age (years)	-0.002	0.005	0.000	0.002	-0.465	0.681	-0.010	0.242
Age (years) (squared)	0.000	0.000	0.000	0.000	0.004	-0.007	0.002	-0.002
Gender (female)	-0.014	**-0.046***	-0.058	**-0.037****	-3.404	**-6.829***	**-8.734***	**-6.056*****
Education (1-5)	0.000	0.020	0.005	0.009	-0.415	3.063	0.806	1.096
Income spent on food (1-5)	0.000	-0.013	-0.005	-0.007	-0.868	-1.974	-0.775	**-1.457***
Difficult to meet food needs (dummy)	-0.012	0.044	-0.001	0.012	-2.419	6.587	-0.223	1.355
Food needs fully met (dummy)	-0.017	0.019	0.042	0.002	-1.770	2.882	6.197	0.584
Share of production sold (0-1)	0.044	0.010	-0.036	0.012	5.552	1.690	-5.389	1.510
Trusting other farmers (dummy)	0.008	-0.017	0.004	-0.012	-0.596	-2.576	0.601	-2.292
Not trusting other farmers (dummy)	**0.074****	-0.038	-0.025	-0.009	8.389	-5.698	-3.846	-2.021
Believe others are fair (dummy)	-0.035	0.030	**0.062***	0.018	-3.297	4.592	**9.385***	3.107
Believe others are unfair (dummy)	-0.010	**-0.067***	-0.003	-0.019	1.766	**-9.990****	-0.444	-2.411
Risk aversion, experiments (0-10)	-0.002	0.003	0.007	0.003	-0.381	0.391	1.036	0.399
Impatience, experiments (0-10)	0.002	-0.002	-0.002	0.000	0.419	-0.242	-0.337	0.075
Tanzania (dummy)				0.032				5.227
Constant term	**0.245*****	-1.023	**0.589****	**0.139***	-153.273	-153.273	**88.599*****	**24.536****
Experimenter fixed effects	YES	NO	NO	NO	YES	NO	NO	NO
Session fixed effects	YES	YES	YES	YES	YES	YES	YES	YES
Sample size	504	477	500	1,481	504	477	500	1,481
R-squared	0.259	0.206	0.303	0.221	0.620			0.328
Log-likelihood	214.989	-28.022	-22.509	56.100	-2.3e+03	-2.4e+03	-2.5e+03	-7.4e+03
AIC	-363.978	138.045	125.018	29.800	4,709.005	4,915.109	5,132.303	14,887.81
BIC	-224.633	308.913	293.602	406.133	4,848.350	5,090.145	5,305.102	15,264.14
Power	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000

Notes: All the models were selected based on their AIC and BIC values: [1] OLS; [2] Left-censored (0) and right-censored (150) Tobit models. Significance levels: *** p<0.01, ** p<0.05, * p<0.10.

Table 10. Models for group-level contributions (relative and per person) in both rounds, in the single countries and across all countries.

Models for group-level contribution in single rounds	Total contribution relative to total endowment				Contribution per person			
	Kenya	Tanzania	Tunisia	All countries	Kenya	Tanzania	Tunisia	All countries
Round with lower return (dummy)		-0.011		0.017		-1.684		2.588
Round with lower return # 2nd round		0.013		-0.039		1.991		-5.791
Round with inequality (dummy)	**0.330*** **			**0.097*** **	**49.225*** **			**14.184*** **
2nd round (dummy)		**-0.197*** **	**-0.236*** **	**-0.264*** **		**-29.500*** **	**-35.454*** **	**-39.561*** **
Relative contribution (round 1)	**0.688*** **	**0.533*** **	**0.714*** **	**0.767*** **	**103.186*** **	**79.997*** **	**107.155*** **	**114.953*** **
Group size (Session size in Tunisia)	0.001	0.014	0.000	-0.003	0.138	2.083	-0.063	-0.367
Average share of known farmers (0-1)		0.030	-0.047			4.555	-7.045	
Average age (years)	-0.002	0.000	0.004	0.000	-0.376	0.024	0.569	-0.080
Female farmers (share, 0-1)	-0.073	0.021	-0.044	**-0.055** **	-10.537	3.214	-6.653	**-8.161** **
Average education (1-5)	-0.019	-0.017	0.006	-0.015	-2.916	-2.529	0.829	-2.338
Average income spent on food (1-5)	-0.031	**-0.061* **	**0.050** **	-0.011	-4.088	**-9.081* **	**7.437** **	-1.591
Farmers not meeting food needs (share, 0-1)	0.040	-0.024	0.013	0.034	3.988	-3.548	1.982	5.070
Farmers with food needs fully met (share, 0-1)	-0.026	0.007	0.057	0.004	-3.269	0.994	8.593	1.140
Average share of production sold (0-1)	0.122	0.015	0.026	0.044	18.647	2.213	3.842	6.505
Farmers trusting others (share, 0-1)	0.039	0.033	**0.113** **	-0.019	7.487	4.957	**17.018** **	-2.613
Farmers not trusting others (share, 0-1)	**0.275* **	-0.023	**0.117** **	**0.082* **	**43.785* **	-3.442	**17.562** **	**12.407* **
Farmers believing others are fair (share, 0-1)	-0.002	-0.060	**0.230*** **	0.040	-1.846	-9.048	**34.558*** **	5.997
Farmers believing others are unfair (share, 0-1)	0.041	-0.009	0.011	0.022	3.776	-1.410	1.612	3.064
Average risk aversion, experiments (0-10)	0.020	-0.014	-0.023	-0.003	3.220	-2.170	-3.500	-0.421
Average impatience, experiments (0-10)	0.007	-0.003	-0.013	-0.002	1.042	-0.509	-1.973	-0.303
Tanzania (dummy)				-0.023				-3.561
Constant term	0.201	0.550	0.108	**0.519*** **	27.693	82.513	16.169	**77.687*** **
Sample size	98	96	100	294	98	96	100	294
R-squared	0.418	0.259	0.593	0.442	0.416	0.259	0.593	0.439
Log-likelihood	110.136	97.840	108.223	292.273	-381.792	-383.181	-392.840	-1.2e+03
AIC	-186.273	-155.680	-180.446	-542.546	797.585	806.362	821.681	2,405.684
BIC	-142.328	-104.393	-133.553	-465.191	841.529	857.649	868.574	2,483.039
Power	0.9991	0.7839	1.0000	1.0000	0.9990	0.7839	1.0000	1.0000

Notes: All the models are OLS and were selected based on their AIC and BIC values for their country. Significance levels: *** p<0.01, ** p<0.05, * p<0.10.

Table 11. Models for change in group-level contributions (relative and per person) between rounds, in the single countries and across all countries.

Models for change in group-level contribution between rounds	Total contribution relative to total endowment				Contribution per person			
	Kenya	Tanzania	Tunisia	All countries	Kenya	Tanzania	Tunisia	All countries
Round with lower return (dummy)		-0.033		-0.027		-4.973		-4.017
Previous round with inequality (dummy)				-0.044				-6.663
Relative contribution (round 1)	**-0.189****	**-0.322****	-0.064	**-0.194*****	**-28.331****	**-48.291****	-9.598	**-29.073*****
Group size (Session size in Tunisia)	0.000	0.037	-0.007	-0.001	-0.058	5.617	-1.118	-0.175
Average share of known farmers (0-1)		0.007	-0.163			0.990	-24.459	
Average age (years)	-0.001	0.000	0.000	-0.001	-0.213	0.005	-0.029	-0.168
Female farmers (share, 0-1)	-0.063	-0.031	0.001	**-0.073****	-9.497	-4.676	0.136	**-10.936****
Average education (1-5)	-0.040	0.037	-0.029	**-0.037****	-6.056	5.578	-4.414	**-5.560****
Average income spent on food (1-5)	-0.017	**-0.070***	0.033	-0.011	-2.572	**-10.526***	5.004	-1.641
Farmers not meeting food needs (share, 0-1)	0.014	-0.247	-0.020	-0.036	2.052	-37.064	-3.026	-5.422
Farmers with food needs fully met (share, 0-1)	-0.012	**-0.262***	-0.087	-0.048	-1.871	**-39.233***	-13.056	-7.186
Average share of production sold (0-1)	0.069	0.038	0.076	0.070	10.314	5.685	11.462	10.451
Farmers trusting others (share, 0-1)	0.095	-0.068	0.044	0.035	14.304	-10.267	6.609	5.311
Farmers not trusting others (share, 0-1)	**0.232***	**-0.328***	0.074	0.071	**34.783***	**-49.134***	11.111	10.635
Farmers believing others are fair (share, 0-1)	-0.095	0.162	0.158	0.035	-14.197	24.368	23.742	5.319
Farmers believing others are unfair (share, 0-1)	-0.078	-0.004	0.054	-0.013	-11.771	-0.555	8.110	-1.943
Average risk aversion, experiments (0-10)	-0.018	-0.004	0.002	-0.005	-2.683	-0.551	0.249	-0.768
Average impatience, experiments (0-10)	0.015	0.003	-0.013	0.004	2.237	0.392	-1.922	0.599
Tanzania (dummy)				**-0.049***				**-7.408***
Constant term	**0.379***	0.126	0.222	**0.368*****	**56.888***	18.890	33.232	**55.130*****
Sample size	49	48	50	147	49	48	50	147
R-squared	0.438	0.501	0.296	0.272	0.438	0.501	0.296	0.272
Log-likelihood	84.734	64.594	60.754	181.641	-160.787	-175.917	-189.777	-554.923
AIC	-137.469	-93.188	-87.509	-325.281	353.573	387.833	413.555	1,147.845
BIC	-107.200	-59.506	-55.004	-268.463	383.843	421.515	446.059	1,204.664
Power	0.7949	0.8632	0.3759	0.9909	0.7949	0.8632	0.3759	0.9909

Notes: All the models are OLS and were selected based on their AIC and BIC values for their country. Significance levels: *** p<0.01, ** p<0.05, * p<0.10.

5. Conclusion and policy implications

By analysing the PGG contributions of smallholders from three African countries, we could assess the impact of elements that may affect cooperation with peers in the process of adopting and managing collective innovations. These elements affect cooperation, but not always in the expected direction. For instance, while we observe no significant differences between farmers experiencing different rates of return at the same time, those experiencing subsequent drops in this rate reduce their contribution. Second, poorer farmers cooperate less in absolute and relative terms but endowment inequality results in higher 'payoff efficiency'. Third, farmers reduce their contribution if others have contributed relatively less, and vice versa, but larger cooperators keep cooperating more. Finally, group size does not seem to matter.

Based on the above results, we can draw recommendations for the dissemination and management of innovations. First, we advise against dissemination strategies that promise unrealistically high returns: it is preferable to adopt cautious approaches, and make the risks clear, rather than disappointing smallholders with lower-than-expected, or decreasing returns. Second, operating with large farmers' groups would not necessarily represent an obstacle and can rather be beneficial to spread risk, including free riding risk. Third, involving farmers endowed with different levels of resources is unlikely to be a challenge either. Richer smallholders may rather become early adopters, increasing their group's investment in innovation, and possibly support poorer peers. Finally, cooperation might deteriorate over time if large cooperators experience recurrent free riding in their group; equally, less cooperative groups are likely to remain so. To avoid vicious circles of downward cooperation, support through pre-existing organisational structures (NGOs, extension services) is required.

Although the stylised facts identified represent helpful guidelines for innovation dissemination, caution is needed before drawing too general conclusions, as external validity can be limited for reasons related to the implementation context and our own PGG design. First, while the Covid-19 pandemic and resulting restrictions seem to have had limited impact on implementation, they may have affected the mindset and the decisions of the participant smallholders in unexpected ways, e.g., lower attention or higher risk aversion. Second, our samples are representative of specific regions and may not be comparable to others due to, e.g., ethnic or agri-environmental diversity. Third, even if we provided smallholders with examples related to farming, our 'artefactual field experiments' (Harrison & List, 2004) use high levels of abstraction; hence, decisions in very specific cooperative situations may differ.

In terms of PGG design, for interpretability reasons we limited our treatments to two levels for the multiplication factor, and two endowment levels in the presence of inequality. The dynamics detected may not necessarily extend beyond such ranges. Equally, we only implemented two rounds, and the group size was not systematically varied; hence, the results in this regard must be considered with care. In turn, there is compelling evidence that cooperation is domain-general and temporally stable (Peysakhovich et al., 2014).

Future experimental research might consider more treatment levels, and increase the number of decisions. Then, the impact of the same elements on smallholders' adoption of collective innovations could be tested through randomised controlled trials.

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Author contribution statement

Conceptualisation: SP, MS; Methodology: SP, LK, MS; Survey and experimental protocols: SP, LK, MS; Validation: SP; Formal analysis: SP; Investigation: BM, FM, EC; Resources: BM, FM, EC; Data curation: SP, LK; Writing – original draft: SP, AB, MS; Writing – review & editing: SP, LK, AB, BM, FM, EC, MS; Visualisation: SP; Supervision: SP, MS; Project administration: LK, MS; Funding acquisition: MS.

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Annex

Table 12. Descriptive statistics for the group-level sample, by country and across all countries.

Variable	Kenya		Tanzania		Tunisia		All countries		Difference (p-value)
	Mean	**St. dev.**	**Mean**	**St. dev.**	**Mean**	**St. dev.**	**Mean**	**St. dev.**	
Relative contribution (round 1)[2]	0.494	0.107	0.386	0.103	0.423	0.107	0.434	0.114	0.000***
Contribution (round 1)	73.831	16.238	57.857	15.477	63.376	16.117	65.059	17.170	0.000***
Relative contribution (round 2)	0.504	0.101	0.401	0.101	0.488	0.141	0.465	0.124	0.000***
Contribution (round 2)	75.544	15.176	60.209	15.195	73.196	21.196	69.738	18.603	0.000***
Change in relative contribution	0.011	0.058	0.016	0.090	0.065	0.086	0.031	0.083	0.002***
Change in contribution	1.713	8.677	2.352	13.521	9.820	12.965	4.679	12.402	0.002***
Group size	10.286	3.714	10.042	0.355	10.000	0.000	10.109	2.143	0.935
Age (years)	51.184	7.750	41.138	6.301	45.508	5.625	45.973	7.747	0.000***
Gender (female)	0.458	0.267	0.414	0.201	0.466	0.302	0.446	0.260	0.702
Education (1-5)	3.177	0.452	2.714	0.287	2.714	0.555	2.868	0.495	0.000***
Income spent on food (1-5)	2.486	0.479	2.978	0.410	3.334	0.667	2.935	0.634	0.000***
Difficult to meet food needs (dummy)	0.295	0.153	0.443	0.174	0.692	0.179	0.479	0.236	0.000***
Food needs fully met (dummy)	0.489	0.204	0.404	0.162	0.138	0.121	0.342	0.223	0.000***
Share of production sold (0-1)	0.562	0.100	0.378	0.113	0.332	0.162	0.424	0.162	0.000***
Trusting other farmers (dummy)	0.645	0.139	0.515	0.192	0.234	0.265	0.463	0.268	0.000***
Not trusting other farmers (dummy)	0.069	0.081	0.087	0.091	0.258	0.203	0.139	0.161	0.000***
Believe others are fair (dummy)	0.486	0.178	0.311	0.135	0.306	0.207	0.368	0.194	0.000***
Believe others are unfair (dummy)	0.153	0.129	0.148	0.117	0.274	0.236	0.193	0.179	0.013**
Risk aversion, experiments (0-10)	5.640	0.772	5.507	0.799	4.668	0.951	5.266	0.945	0.000***
Impatience, experiments (0-10)	3.146	0.920	2.641	1.399	3.010	1.240	2.935	1.212	0.083*
Share of participants known (0-1)	-	-	0.272	0.265	0.339	0.145	0.306	0.214	0.066*
Sample size (per round)	49		48		50		147		

Notes: [1] Kruskal-Wallis test of difference between countries. Significance levels: *** p<0.01, ** p<0.05, * p<0.10. [2] This is also the value of past group-level contribution used as w.