Cooperative Networks: Altruism, Group Solidarity, Reciprocity, and Sanctioning in Ugandan Producer Organizations[1]

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Repeated interaction and social networks are commonly considered viable solutions to collective action problems. This article identifies and systematically measures four general mechanisms—that is, generalized altruism, group solidarity, reciprocity, and the threat of sanctioning—and tests which of them brings about cooperation in the context of Ugandan producer organizations. Using an innovative methodological framework that combines "lab-in-the-field" experiments with survey interviews and complete social networks data, the article goes beyond the assessment of a relationship between social networks and collective outcomes to study the mechanisms that favor cooperative behavior. The article first establishes a positive relationship between position in the network structure and propensity to cooperate in the producer organization and then uses farmers' behavior in dictator and public goods games to test different mechanisms that may account for such a relationship. Results show that cooperation is induced by patterns of reciprocity that emerge through repeated interaction rather than other-regarding preferences like altruism or group solidarity.

Repeated interaction and social networks are commonly considered viable solutions to collective action problems (Gould 1993; Marwell and Oliver 1993; Kim and Bearman 1997; Diani and McAdam 2003). In a related vein,

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many studies of social capital assume that social networks and associational life can be beneficial to the collectivity (Coleman 1990; Portes 1998; Putnam 2000; Lin, Cook, and Burt 2001). However, assessing the relationship between social networks and prosocial behavior is not sufficient in order to determine the building blocks of cooperation. If one wants to understand how cooperation emerges in a specific social setting, it is important to focus on how patterns of social relations affect actors' motives and their expectations about others' behavior. In other words, we need to go beyond the observation that patterns of social relations matter for cooperation, to study the mechanisms through which social relations may enhance collective outcomes.

Scholars have advanced different theories. On the one hand, there are interest-based explanations according to which repeated interactions set the basis for reciprocity and mutual sanctioning; repeated interaction makes it convenient for individuals to cooperate because long-term gains will offset the benefit of one-shot free riding. On the other hand, there are other-regarding explanations based on altruism, group solidarity, and norms of fairness (Axelrod 1984; Gambetta 1988; Ostrom 2000; Fehr and Gächter 2002; Nowak and Sigmund 2005). However, in both the literature on collective action and that on social capital, these mechanisms are rarely compared with each other or tested across diverse settings (Cook, Levi, and Hardin 2009). In this article, I identify and systematically measure four general mechanisms, that is, generalized altruism, group solidarity, reciprocity, and the threat of sanctioning.

This article makes three theoretical contributions. First, it organizes the vast, multidisciplinary literature on decentralized solutions to collective action problems into four distinctive mechanisms and discusses their scope conditions. Second, it articulates the different ways in which social networks are implicated in each of the four mechanisms, thus contributing to our general understanding of the role of social networks in bringing about cooperation in small groups. Third, it connects the literature on collective action and social capital to some recent developments in behavioral economics, providing a blueprint for research design in this area.

I test the four alternative mechanisms in a context uniquely suited to this goal: Ugandan farmer cooperatives that face collective action problems on a regular basis. These producer organizations were created as part of Uganda's largest recent rural development intervention, whose goal was to support small farmers' integration into commercial farming by exploiting

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economies of scale and improving their productivity and management skills. By adopting an innovative methodological framework that combines "lab-in-the-field" experiments with survey interviews and complete social networks data, this article goes beyond the assessment of a relationship between social networks and collective outcomes to study the mechanisms that undergird cooperative behavior. To achieve this goal, I took behavioral games, typically conducted in a laboratory environment, to the field. Members of farmer cooperatives participated in different variants of the dictator game and public goods game, providing reliable behavioral measures of their other-regarding preferences and cooperative capacity.

The empirical analysis unfolds as follows. First, relying on detailed social network information, I assess the relationship between social network position and collective outcomes, showing that farmers with greater network centrality and nonredundant social ties are more cooperative and participate more in the life of their producer organization. Second, I use lab-in-the-field experiments to distinguish between different mechanisms, such as generalized altruism, group solidarity, reciprocity, and threat of sanctioning. This experimental component of the research makes it possible to establish the causal effect of group attachment on prosocial behavior and the causal effects that repeated interaction and the threat of sanctioning both have on cooperation.

Not only does performing laboratory experiments in a field setting with members of preexisting groups increase the external and ecological validity of the findings; more importantly, it makes it possible to relate experimental behavior to "real-life," observational behavior. That is, in the third part of the analysis I relate farmers' behavior in behavioral games to their level of cooperation in the producer organization in order to identify which mechanisms are more likely to account for levels of cooperation in the farmer groups. In this framework, the experimental intervention is therefore used as a "petri dish" to isolate the mechanisms that are likely to be at work in "real life." Results show that, in the context of the farmer organizations object of this study, cooperation is not induced by other-regarding mechanisms such as generalized altruism or group solidarity. Rather, it is the mechanism of reciprocity that emerges through sustained interaction that facilitates cooperation among local producers.

COOPERATION FROM FIRST PRINCIPLES

Public goods provision is usually framed as a problem of cooperation between self-interested actors: in a context in which public goods are nonexcludable, rational, self-interested actors would rather free ride on others' contribution than cooperate (Olson 1965). The success of this analytical framework is due to its capacity to capture the tension between individual

and collective interest—"the disparity between individual optimization and collective optimality" (Coleman 1989, p. 5)—and therefore reveal the social dilemma that limits the occurrence of many instances of collective action.[2] However, even supporters of rational choice approach(es) have conceded that we see more cooperation than expected under the assumption of selfish actors (Opp 1999; Elster 2007; Fehr and Gintis 2007; Kronenberg and Kalter 2012), and over the years, the debate on the problem of collective action has expanded to include aspects that transcend its original formulation (Gould 1993; Marwell and Oliver 1993; Heckathorn 1996; Ostrom 1998; Baldassarri 2009). Various solutions have been advanced to explain how individuals could possibly overcome collective action problems. Here, I organize them along two analytical dimensions: (*a*) the motives actors have for cooperation and (*b*) the beliefs actors hold about others' behavior. In general, the mechanisms here identified should not be simply considered as cognitive or motivational, because they are also affected by actors' expectations about other actors and by their definition of the situation (cf. Ostrom's [2010] concept of "action situation").[3]

Motives

Scholars have ranged the entire spectrum from selfish to altruistic behavior in discussing the *motives actors have for cooperation*. Without necessarily abandoning the assumption of self-interested actors, scholars have advanced solutions to the collective action problem based on selective incentives (Olson 1965), as well as population heterogeneity and the shape of the production function (Marwell and Oliver 1993). On the opposite side of the motivation spectrum, there are arguments and empirical evidence supporting the altruistic, prosocial nature of human behavior (Fehr and Gächter 2002; Henrich et al. 2006). Finally, evolutionary models have often relied on the heterogeneity of social preferences, arguing that cooperation in society may be due to a balance between egoistic and altruistic types (Ostrom 2000; Fehr and Gintis 2007).

In between purely selfish and purely altruistic alternatives, there are intermediate solutions based on the idea that individuals do not act solely on the basis of selfish motivations but tend to include other-regarding preferences in their cost-benefit calculation, to reflect their level of inequity aversion (Fehr and Schmidt 1999; Barr, Lindelow, and Sernees 2009), or their attachment toward kin, social groups, or members of their social

[2] A social dilemma is "a situation in which actions that are individually rational can lead to outcomes that are collectively irrational" (Heckathorn 1996, p. 250).

[3] Moreover, they should also be conceived as orientations that develop as a consequence of group membership, repeated interaction, etc., instead of being conceived as enduring qualities of the person.

networks (Gould 1993; Kim and Bearman 1997; Chen and Li 2009). Social life is in fact regulated by norms of fairness that constrain selfish behavior (Durkheim [1893] 1984; Coleman 1988; Elster 1989; Baldassarri and Grossman 2013). Recent studies have demonstrated that generosity increases as the social distance between ego and alter diminishes. Individuals are most generous toward people they are directly connected to and exhibit greater prosocial behavior toward people who are a few steps removed in their social network (e.g., friends of friends) than toward more distant others (Leider et al. 2009; Brañas-Garza et al. 2010; Goeree et al. 2010; Apicella et al. 2012). More generally, individuals are more generous toward in-group than out-group members. In-group favoritism has been observed not only in field settings where group membership is based on ascribed categories, such as, for instance, ethnicity (Whitt and Wilson 2007) and religion (Adida, Laitin, and Valfort 2010), but also in cases in which group membership was randomly assigned (Goette, Huffman, and Meier 2006), and even in laboratory settings where scholars induced "minimal" or trivial group identities (Tajfel and Turner 1979; Bohnet and Frey 1999; Chen and Li 2009).[4]

In this research I consider two types of motives that deviate from selfish behavior: *generalized altruism*, which identifies prosocial behavior toward unidentified "others," and *group solidarity*, which identifies prosocial behavior toward members of one's social group.

Expectations

The second relevant dimension in the analysis of collective action dilemmas concerns the *expectations actors hold about others*. Under certain conditions, cooperation can emerge even among self-interested actors. And, on the contrary, "even if people's motives are not unquestioningly egoistic, cooperation might still encounter many obstacles" (Gambetta 1988, p. 216). For instance, in the classic prisoner's dilemma situation, the expectation that the other actor would defect might actually induce a potentially cooperative actor to defect as well. "The problem, therefore, is essentially one of communication: even if people have perfectly adequate motives for cooperation they still need to know about each other's motives and to trust each other, or at least the effectiveness of their motives. It is necessary not only to trust

[4] Analytically, it is important to note that in-group favoritism can be brought about by two distinct, although interdependent, processes: social proximity, which is related to the frequency of interaction and the nature of the relationship between actors, and group attachment, which derives from the strength of one's identification with a group (Baldassarri and Grossman 2013). Though both social proximity and group attachment may lead to in-group favoritism, proximity is based on particularized past experiences, while group attachment derives from a process of categorization in which individuals generalize their interpersonal experiences to a broader class of alters and relate to others even in the absence of a personal relationship (Tajfel and Turner 1979).

others before acting cooperatively, but also to believe that one is trusted *by* others" (Gambetta 1988, p. 216).

Almost all formal models of collective action subsequent to Olson's (1965) seminal work included some form of *interdependence between actors*. Interdependence, in most conditions, reduces the uncertainty ego faces about alter's behavior, thus making it easier to establish whether alter will cooperate or not, as well as to persuade alter of ego's cooperative intentions. Repeated interaction represents the simplest form of interdependence and can in itself foster cooperative behavior by allowing reciprocity to evolve, as demonstrated by Axelrod's (1984) evolution of cooperation via a two-person iterated prisoner's dilemma (i.e., Rapoport's tit-for-tat strategy). While in a one-shot interaction individuals might benefit from selfish behavior, in repeated interaction, defection might no longer be the best strategy for a self-regarding actor, because his defection might lead to alter's defection in future interactions. The successful strategy in the longer run is to elicit cooperation from the other actor.

Mechanisms of direct ($A \rightarrow B$, $B \rightarrow A$) and indirect ($A \rightarrow B$, $B \rightarrow C$) reciprocity predicated on the same logic have acquired a central role in evolutionary biology in recent years, as they are often used to explain altruistic behavior toward nonkin and the evolution of cooperation in relatively large social groups (Trivers 1971; Nowak and Sigmund 2005). Similarly, social exchange theorists have highlighted the consequences of reciprocal and generalized exchange on collective outcomes (Yamagishi and Cook 1993; Bearman 1997; Molm 2010). It should be noticed that reciprocity, as conceived here, does not necessarily require actors to carry other-regarding preferences. Indeed, in the context of repeated interaction, reciprocity might constitute the most effective behavior even for a fully selfish actor.

Mechanisms of direct and indirect reciprocity may emerge through contact between actors, since communication could enable individuals to coordinate, persuade, precommit, and signal trustworthiness. Although verbal commitment is not binding, in certain instances communication has been shown to be sufficient to trigger cooperation, by affecting the beliefs actors have about each other's behavior (Ostrom, Walker, and Gardner 1992). Formal models of collective action that incorporate a network structure (Gould 1993; Kim and Bearman 1997) as well as threshold models and cascades (Granovetter 1978; Macy 1991; Watts and Dodds 2007) often rely on this mechanism.

However, as forcefully argued by rational choice theory scholars, communication is not binding and can actually be deceptive—it is "cheap talk"—and thus may not necessarily affect actors' behavior or lead to Pareto-efficient outcomes (Farrell and Rabin 1996). *Monetary and social sanctioning* is often considered to be a more effective mechanism to foster cooperation in a context of repeated interaction (Fehr and Gächter 2002;

Sigmund 2007). The threat of a fine, loss of reputation, or exclusion from the group serves as a deterrent from free riding because these sanctions change individuals' payoff function, increasing the cost of defection (Obershall 1973; Heckathorn 1990; Willer 2009). Moreover, the presence of a sanctioning system also serves as a reassurance for potential cooperators that defection would not go unpunished and thereby strengthen people's beliefs that others would cooperate. Coercion is a way "to circumscribe the extent to which we need to trust agents or cope with them in case of distrust" (Gambetta 1988, p. 220).

In addition to generalized altruism and group solidarity, in this research I consider two other mechanisms that might lead to greater cooperation in a context of repeated interaction: *reciprocity based on verbal commitment* and *the threat of sanctioning*. Both mechanisms affect the beliefs actors have about other actors' behavior.

Scope Conditions

These mechanisms are derived from different theories of collective action that span a few disciplines and, unfortunately, have been seldom compared to each other. A discussion of their scope conditions is also missing. For sure, from a theoretical standpoint, generalized altruism, group solidarity, reciprocity, and the threat of sanctioning are not mutually exclusive; indeed, several instances of collective action may be brought about by a combination of these mechanisms (Ostrom 2005). Moreover, instead of comparing them in the abstract, we should specify their scope conditions by identifying the actual collective action forms and contexts in which they are more likely to operate.

First of all, all these mechanisms generally apply to small and medium-size groups in which horizontal, decentralized solutions to collective action problems emerge more easily. Instead, in large groups (e.g., countries, large markets), centralized solutions (e.g., the police, taxation, central banks) are often necessary (Scholz and Gray 1997; but see Nee and Opper [2012] for an exception).

While scope conditions are rarely discussed, we can infer them from the substantive research areas from which these theories have originated. Scholars stressing the importance of group solidarity and interpersonal influence are often concerned with instances of collective action that are political in nature (e.g., volunteering, protest mobilization, political participation), where group dynamics and the symbolic meaning of the collective goal may accrue disproportionate importance over instrumental considerations (Bearman 1991; Gould 1995; Diani and McAdam 2003). This is especially the case when considering high-risk forms of collective action, such as in the case of participation in violent protests, revolutions, or suicide

missions, in which the effect of peer pressure and the importance of group solidarity are fundamental in explaining participation (McAdam 1986; Gambetta 2005).

Although recognizing the importance of group membership and shared norms, studies that examine collective action problems in the context of primarily economic activities have instead focused mainly on instrumental reasons; consider, for instance, the vast literature on common-pool resources, which addresses problems of overuse of resources such as fisheries, pastures, water, atmosphere, and so forth (Hardin 1968; Ostrom 1990). In this context, a system for monitoring and sanctioning is usually regarded as the most effective solution to collective action problems (Fehr and Gächter 2002; Camerer 2003; Habyarimana et al. 2007; Sigmund 2007). However, the empirical work of Elinor Ostrom and her collaborators also greatly contributed to show that communication and mechanisms of reciprocity help promote and sustain cooperation, either by themselves or in combination with peer sanctioning (Ostrom et al. 1992; Ostrom 2010). In addition, group size and heterogeneity are likely to affect which of these mechanisms is more effective. Namely, as the size (or heterogeneity) of the group increases and connections become sparser, reciprocity based on communication becomes more difficult to sustain, and sanctioning mechanisms must be put in place to discourage free riding (Ruttan 2008; Poteete, Janssen, and Ostrom 2010).

Finally, explanations of collective action based on generalized altruism may be advanced in the presence of strong selection (or self-selection) processes, in which "altruistic types" combine their cooperative efforts, for example, in the case of volunteering. In addition, differences in levels of generalized altruism or in the proportion of altruistic types in a population are sometimes useful to understand cross-cultural comparisons, and it is probably at this macrolevel that this type of explanation is most effective (Yamagishi, Cook, and Watabe 1998; Henrich et al. 2001, 2010; Herrmann, Thóni, and Gächter 2008).

NETWORKS, SOCIAL CAPITAL, AND PROSOCIAL BEHAVIOR

Social networks may be implicated in all the mechanisms discussed so far, although the way in which networks could matter is different for each of them. Let us consider group solidarity. As reviewed before, social ties to and from alters contribute to shaping ego's motives and his or her other-regarding preferences. The mechanism of group solidarity is indeed predicated on the idea that the extent to which ego takes into account alters' welfare is a function of ego's social distance from alter (Tajfel and Turner 1979). Norms of fairness toward a social group depend on the attachment and frequency of exposure to the members of the group (Goette et al. 2006; Whitt and Wilson 2007; Baldassarri and Grossman 2013). For instance,

the extent to which people would forgo possible gains to benefit family members or close friends is usually greater than if they were to sacrifice for their coworkers or casual acquaintances. We can therefore expect that the more connections one has to members of a group and the more embedded he is in such a group, the more he is likely to develop group solidarity and behave prosocially toward members of such a group.

The relation between social network position and generalized altruism is instead less obvious. There is experimental evidence suggesting that having social ties that extend beyond the family and a close circle of friends is likely to induce greater trust in strangers, while intense family and group ties prevent trust from developing beyond group boundaries (Ermisch and Gambetta 2010; Yamagishi 2011). Similarly, network centrality has been found to be associated with greater trusting and trustworthy behavior in an investment game (Barr, Ensminger, and Johnson 2009). It is possible to expect other-regarding preferences to be similarly affected. Namely, individuals with more extensive and outreaching networks may display greater levels of generalized altruism. Extant scholarship relating network centrality to generosity and cooperative behavior offers rather mixed empirical evidence (D'Exelle and Riedl 2010; Apicella et al. 2012). One should also consider a reversed causality pattern: namely, altruistic individuals may be more likely to have broad social networks. Either way, we cannot exclude, a priori, the possibility of a relationship between social network position and generalized altruism.

Let us now consider how networks can affect the remaining two mechanisms: reciprocity based on communication and the threat of sanctioning. Social networks govern actors' interdependence and favor repeated interaction, thus contributing to determining ego's beliefs about alters' motives. Social networks are pipelines through which individuals exchange information. They also enable mechanisms of interpersonal influence and peer pressure. Patterns of relationship are therefore vital for the development of forms of direct and indirect reciprocity (Nowak and Sigmund 2005; Apicella et al. 2012). Similarly, sanctioning systems are often more effective in the presence of interpersonal relationships, which allow for better enforcement and greater social control (Coleman 1988; Greif 1993; Fershtman and Gneezy 2001; Sigmund 2007).

In the light of these considerations, it becomes clear that assessing the relationship between social networks and prosocial behavior is not sufficient in order to determine the building blocks of cooperation. If one wants to understand the mechanisms through which cooperation emerges in a specific social setting, it is important to focus on how patterns of social relations affect actors' motives (i.e., increasing group solidarity or generalized altruism) or their expectations about others' behavior (i.e., facilitating reciprocity and sanctioning mechanisms).

Advancements in this direction would contribute not only to the research on collective action but also to the large scholarship on social capital. Although it is beyond the scope of this section to cover the various strands of this popular concept in the social sciences,[5] it should suffice to say that, at their core, most conceptions of social capital stem from the idea that social relationships and associational life can positively affect individual and group outcomes.[6] Unfortunately, most scholars have based their arguments on the generic assumption that social capital nurtures trust and norms of reciprocity, without specifying the microlevel mechanisms through which social capital informs social and economic behavior (see, e.g., Fukuyama 1995; Putnam 2000). These macrolevel and cultural approaches quite often also rely on tautological explanations and fail to analytically distinguish between social capital and its consequences (for an account of these problems, see Portes [1998] and Abascal and Baldassarri [2015]).

In contrast, scholars who have devoted attention to the microlevel mechanisms at the basis of social capital's positive outcomes (Portes 1998; Lin et al. 2001; Burt 2005; Durlauf and Fafchamps 2005) tend to adopt a framework similar to the one discussed in the previous section. For instance, in his widely cited review of the literature, Portes (1998) points to the relational nature of social capital: it is the fact that alters will behave according to certain norms of conduct that allows ego to secure benefits through his social network. Moreover, Portes organizes the sources of social capital into two broad categories: consummatory sources, which are based on mechanisms of value introjection or bounded solidarity at the community level, and instrumental sources, based instead on norms of reciprocity and enforceable trust. These four mechanisms closely resemble the four mechanisms considered in this research.

In sum, both collective action and social capital scholarship suggest that there are multiple ways in which social networks may affect collective outcomes and cooperation. Identifying which mechanism is at work, that is, generalized altruism, group solidarity, reciprocity based on verbal commitment, or the threat of sanctioning, is crucial in order to understand the contextual and institutional factors that bring about cooperation in specific social settings.

[5] Social capital has become a very popular concept in the social sciences in the last 20 years, with wide application in sociology (Coleman 1990; Portes 1998; Lin et al. 2001), as well as political science (Fukuyama 1995; Foley and Edwards 1996; Putnam 2000; Krishna 2002) and economics (Woolcock 1998; Durlauf and Fafchamps 2005). Its diffusion testifies to its appeal in explaining social processes. Simultaneously, social capital has also become an all-encompassing concept, often vaguely defined and carelessly deployed.

[6] As Portes puts it, social capital can be defined as "the ability of actors [individuals or groups] to secure benefits by virtue of membership in social networks or other social structures" (1998, p. 6).

BEHAVIORAL GAMES AND LAB-IN-THE-FIELD EXPERIMENTS

Motives and expectations are not immediately observable. However, it is possible to infer them from the way people behave in controlled, experimental settings, and in behavioral games (BGs) in particular. BGs are abstract situations in which individuals have to allocate resources between themselves and other players. BGs are uniquely suited to capture actors' interdependence in decision making, because in order to define their own strategies, participants must take into account their expectations concerning the behavior of other players.

Despite the scarce use of BGs in sociology (which, I believe, is partly due to their initial association with economics and rational choice theory), in recent years there has been an interesting evolution in the use of BGs that has made them a promising tool for the social sciences, and sociology in particular.[7] Initially, behavioral experiments were developed to reveal general patterns of human behavior (Marwell and Ames 1979; Fehr and Gächter 2002; Camerer 2003), using convenience samples (often college students) and experimental settings and protocols that guaranteed complete anonymity and, as much as possible, "stripped" participants of their background characteristics and experiences. Over the last two decades, however, some scholars have shifted their interest toward macrocultural variations and started to play BGs with diverse populations around the world (Henrich et al. 2001, 2010; Herrmann et al. 2008; Yamagishi 2011). Finally, in the last 10 years, BGs have started to be used to measure individual and group differences that stem from microcontextual variations as well as personal and group experiences (Barr 2003; Carpenter, Daniere, and Takahashi 2004; Karlan 2005; Fearon, Humphreys, and Weinstein 2009; Ermisch and Gambetta 2010; Grossman and Baldassarri 2012; Baldassarri and Grossman 2013). This last development is critical: that BGs have been shown to be sufficiently sensitive to detect differences between individuals within a society makes them an exceptionally powerful tool for research in those fields of sociology that rely on "hard-to-measure" concepts such as trust, authority, altruism, reciprocity, and solidarity, among others.

Second, the shift in BGs' use from a tool to detect universal patterns of human behavior to a measurement instrument that allows researchers to capture individual and group differences has made the identity and "real-life" experiences of the game participants an integral part of the research design and has led to a move from the aseptic walls of an experimental lab

[7] While a certain skepticism regarding the origins of BGs is understandable, most of the criticisms that motivated the disciplinary rejection of rational choice theory do not apply to more recent use of BGs. Moreover, and quite ironically, behavioral experiments have greatly contributed to the debunking of some basic assumptions at the basis of rational choice theory.

to natural settings. In general, lab-in-the-field behavioral experiments have greater external validity than lab-based BGs (Levitt and List 2007; Jones 2010), because they are carried out with subjects in their natural settings, retaining, to the greatest possible degree, their social identities and context. Moreover, when combined with observational data, they greatly facilitate the inferential process, the identification of social mechanisms, and, under certain conditions, the assessment of causal effects (Baldassarri and Grossman 2011; Grossman and Baldassarri 2012).

Adopting this new framework, I used lab-in-the-field BGs to measure farmer group members' levels of generalized altruism and group solidarity, as well as their cooperation propensity under reciprocity and threat of sanctioning conditions. The full script of the behavioral games is available in the online appendix. Namely, I used different variants of the dictator game (DG) to differentiate between different motives for prosocial behavior. Traditionally, in a classic DG, two subjects are given a common endowment. One of the players, randomly chosen, has to decide how to divide the money between himself or herself and the other player, the receiver. Deciders keep to themselves whatever they have decided to allocate to themselves, while the receivers take home whatever they have been given. The DG is conducted under conditions of anonymity. If deciders were completely selfish, they would keep the entire endowment to themselves. In contrast, individuals share, on average, between 20% and 30% of their endowment. A few share up to half, whereas the modal behavior is to give nothing. Behavior in a DG is usually interpreted as an expression of other-regarding preferences (or inequality aversion) and used to classify individuals as selfish or altruistic types (Camerer 2003; Barr, Lindelow, and Sernees 2009).[8]

Although some people are more altruistic than others, individuals are not universally altruistic or selfish. In contrast, a few studies have documented that prosocial behavior is contingent on the perceived social distance between the giver and the receiver. By changing the information set about the actors, scholars have tested whether norms of fairness vary as a function of the recipient's identity and the level of anonymity of the sender. Some studies have elicited more or less fictional group identities in laboratory settings (Bohnet and Frey 1999), while others have shown the positive effect of group identification on prosocial behavior with respect to ascribed categories, such as ethnicity and gender (Whitt and Wilson 2007;

[8] Some scholars have argued that behavior in DGs can be influenced by social norms (e.g., individuals do what the average person will do) and suggested that individuals might have different preferences but prefer to follow group norms (Konow 2010). In this article, I interpret individuals' behavior in a DG as an indicator of their level of prosocial behavior and remain agnostic as to whether this behavior reflects individuals' preferences or is in part affected by social norms.

Abascal 2015), randomly assigned memberships (Chen and Li 2009; Goette et al. 2012), or shared experiences (Gilligan, Pasquale, and Samii 2014). Scholars have also considered proximity in social networks, and results have shown greater levels of prosocial behavior between individuals who are directly connected, especially if the tie is particularly strong (Leider et al. 2009; Goeree et al. 2010; Apicella et al. 2012). In this research, I follow the strategy of changing the identity of the recipient to distinguish between generalized altruism and group solidarity. Namely, participants will be asked to divide their endowment between themselves and a stranger, to measure their level of generalized altruism, and between themselves and a member of their farmer group, to measure their group solidarity.

I use different versions of an iterated public goods game (PGG) to study the evolution of cooperation under different conditions of interdependence. In a classic PGG, participants anonymously decide how to split an initial endowment between private and public accounts. What players put in the private account remains theirs, while what is contributed to the public account is doubled and redistributed evenly among all group members, regardless of their level of contribution. The most profitable outcome for the group occurs when all players contribute their entire endowment. Nonetheless, regardless of what other people contribute, the most profitable strategy for the individual is to keep the entire endowment in his private account and benefit from what everyone else contributes to the public account. Designed to induce a social dilemma, PGGs capture how players balance self-interest and the well-being of the group (Camerer 2003).

Experimental evidence shows that in PGGs participants initially contribute, on average, between 40% and 60% of their endowment. In repeated games, however, conditional cooperators who wish to avoid being exploited by free riders gradually refrain from cooperation, leading to a drop in contributions in subsequent rounds (Ostrom 2000; Fischbacher, Gächter, and Fehr 2001). By contrast, when participants are allowed to punish other subjects, overall levels of contributions increase, since conditional cooperators can discipline defectors (Lubell and Scholz 2001; Fehr and Gächter 2002; Gintis et al. 2005). While sanctioning is widely considered the most common solution to collective action problems, scholars have also shown that face-to-face communication produces substantial increases in cooperation, thus disconfirming the rational choice expectation that communication without binding commitment is "cheap talk" and would not have any effect on cooperation (Ostrom et al. 1992; Frank, Gilovich, and Regan 1993; Bohnet and Frey 1999). In this research, I implement a communication variant of the PGG to test whether repeated interaction is per se capable of leading members of producer organizations to greater levels of cooperation, and I implement a centralized sanctioning variant to measure the extent to which group members are sensitive to the threat of sanctioning.

ECONOMIC DEVELOPMENT AND SOCIAL CAPITAL

Development scholars regard producer organizations as a core component of poverty reduction strategies (Narayan-Parker 2002; Birchall 2003). State withdrawal (Bates 1981) and the (relative) democratization of public life in many developing countries have encouraged the rapid proliferation of local-level, voluntary-based organizations, which are created to provide collective goods to their members. This proliferation was also driven by the active support of the World Bank, international nongovernmental organizations, and other agencies, which have been working since the mid-1990s with a paradigm that stresses the positive effects of participatory and community-driven development, decentralization, and social capital on development (Hussi 1993; Stockbridge et al. 2003).

Early rural development studies aimed mainly at showing the benefits of organizing farmers (Deininger 1995), while more recent scientific research has increasingly focused on intervention design and the comparison of different intervention strategies, often relying on randomized evaluation (Bingen, Serrano, and Howard 2003; Banerjee and Duflo 2010). Instead of focusing on average intervention effects or variation across interventions, this article focuses on *within-intervention variation* and aims at identifying the endogenous social factors that affect the level of success of an intervention. The farmer organizations that are the object of this study were all created by the same development intervention and were given very similar organizational structures, directives, and goals. However, the rate of success greatly varied across farmer groups, and such variation in outcomes is not accounted for by preexisting conditions (like the level of development of the area), the physical characteristics of the land (e.g., elevation, rainfall, and quality of soil), or ethnic and cultural differences. My working hypothesis is that emerging patterns of social relations have helped certain farmer organizations to overcome collective action problems by facilitating the spread of information, trust, and accountability practices.

Development scholars have already documented the role of social capital in reducing the effects of poverty and inequalities by showing how informal relations and voluntary organizations can favor the spontaneous creation of protection systems and help to overcome collective action problems (Collier 1998; Gittell and Vidal 1998; Grootaert and Bastelaer 2002; Krishna 2002), facilitate the diffusion of information and adoption of agricultural innovations (Fafchamps and Minten 1999; Isham 2000), develop microcredit programs (Khandker 1998; Yunus 1998), and foster civic engagement and the democratic process (Gittell and Vidal 1998; Carrol 2001). Despite its achievements, the economic development research has important limitations. Mostly dominated by a macro (or functionalist) approach to social capital, this research rarely goes beyond the intuition that "better-

connected people do better" to investigate the actual network characteristics from which individuals derive their positional advantage (Sobel 2002). In addition, scholars base their arguments on the generic assumption that social capital nurtures trust and norms of reciprocity, without specifying the mechanisms through which social capital operates or trust is produced. Finally, the measurement of the concept is far from satisfying. Scholars usually rely on survey-based measures of trust and membership in formal and informal associations, while more appropriate measurements—that is, behavioral experiments (Durlauf and Fafchamps 2005) and social networks surveys (Burt 2000; Sobel 2002)—are rarely pursued.

THE STUDY CONTEXT: PRODUCER ORGANIZATIONS IN UGANDA

For its scope, relative uniformity of the intervention, and focus on collective marketing, the Agriculture Productivity Enhancement Project (APEP) offers an extraordinary opportunity to study the building blocks of economic cooperation.[9] One of Uganda's largest recent rural development interventions, APEP helped organize over 60,000 farmers into about 2,500 village-level groups (known as producer organizations, or POs) between 2004 and 2009. These groups were further organized into more than 200 farmer associations (known as depot committees, or DCs) serving, on average, 200 members from 10 neighboring POs.[10] The process of group formation occurred under the guidance of a few project field trainers. As a consequence, APEP groups have similar organizational and governance structure. All strategic decisions are made at the DC level by a farmer association council, which is led by a few executives—usually a manager, chairperson, and secretary—under the supervision of two elected farmer representatives per PO.[11]

The goal of these farmer associations was to support the integration of small-holder producers into commercial farming by exploiting economies of scale, increasing productivity, and bargaining for better prices. Their

[9] APEP was funded by the U.S. Agency for International Development and implemented by Chemonics, a Washington, D.C., consultancy.

[10] While village-level POs had neither the organizational capacity nor the volume to become significant economic entities, DCs were better positioned to exploit economies of scale.

[11] This DC council meets two to four times a year and is responsible for connecting village-level POs to the DC. It is also responsible for providing oversight and monitoring of the DC manager, the most important officeholder, whose responsibilities range from overseeing all wholesale marketing activities to negotiating prices, coordinating the diffusion of information, and organizing training sections. Village-level POs are implementing bodies, mainly responsible for carrying out decisions made at the DC level, passing information from and to the farmers, and training them.

major activity was *collective marketing*, also referred to as "bulking," or selling in bulk. Given the high costs of transportation and market information, in the absence of POs, small farmers' only option is to sell their crops to local middlemen, who likely exploit information asymmetries and bargaining power, offering unorganized farmers below-market prices. By contrast, organized farmers can bypass these middlemen and obtain higher prices through collective marketing (Staatz 1987).

Thus, the most common problem for small producers in rural Uganda (as well as in many other underdeveloped regions around the world) is to bypass these speculative middlemen and sell their products at competitive market prices. Some of the farmer organizations were able to achieve high levels of collective marketing; others did not. Depending on their success, these organizations were also able to provide several other services, from training to input procurement (e.g., buying seedlings, fertilizers, and herbicides in bulk), and offer small loans to their members.

Though highly valuable, most of these activities are subjected to various social dilemmas. First of all, these groups have to overcome *coordination* problems. For instance, in order to sell their crop in bulk, farmers need to agree on a place, day, and time in which all of them will convene to a central location to pool their produce. Second, they have to overcome *threshold* problems, which are situations in which a sufficient number of other participants is needed for the collective activity to become beneficial. For instance, renting a truck to bring the crop to the market becomes convenient only if a sufficient number of other farmers share its cost. Similarly, switching to a more remunerative crop (e.g., coffee) becomes convenient only if enough other farmers actually do the same.

Finally, they have to overcome the quintessential social dilemma, the *free-rider* problem, which is a situation in which everybody would benefit from the provision of a public good, but it is better if others bear the cost of its provision. Collective marketing offers a good example of how these farmer groups constantly face free-rider problems. Through collective marketing, farmer organizations can sell their produce directly to buyers in major markets, bypassing the local middleman. Once a farmer group is in place, however, local middlemen tend to raise their offers to remain competitive. Since middlemen, unlike most farmer groups, collect crops at the farmers' gate and pay cash on delivery, members have a private interest in selling to middlemen.[12] The private gain of selling to middlemen ("defecting"), however, is conditional on a sufficient number of other members selling their crops via the farmer group ("cooperating"). Yet, if too many members defect,

[12] In contrast, when selling their crop through the farmer organization, farmers entrust their produce to the manager and usually have to wait a few weeks before receiving their payment.

collective marketing collapses, and the middlemen will lower their price.[13] Farmer organizations face the free-rider problems in other situations as well. For instance, to increase the quality of their crop, and therefore the selling price, farmers have to use fertilizers and follow labor-intensive procedures, such as handpicking coffee beans, drying them on specific carpets, and so forth. Since farmers mix their coffee and then sell it collectively, the overall quality of the produce depends on everybody's effort. Thus, individual farmers face a constant trade-off between working hard to increase the quality of their produce and instead free riding on the work of others.

A stratified, random, multistage cluster design was used to sample research participants.[14] First, I sampled 50 farmer organizations (DCs). Within each organization, all the members of the farmer association council were interviewed ($N = 1{,}447$). Although the research also included a representative sample of farmers that were drawn from six POs per DC, results reported in this article concern members of the DC councils exclusively. Each council member was surveyed in person by trained interviewers in the respondents' language (i.e., Basoga, Luganda, and Ranyankole) and participated in a series of BGs. The surveys included a social network module that provides complete network information for each of the 50 farmer councils in the sample. Additional information about the farmer organization was collected in group interviews with the DC executives. Data on the DCs' economic activities were also assembled from the associations' books and records when available.[15]

Expectations

In light of the previous discussion on the building blocks of cooperation and their scope conditions, which are the mechanisms that make it possible to overcome free-rider problems in the context of Ugandan farmer cooperatives? Given the economic nature of the activity of these farmer groups, I expect instrumental considerations, and thus mechanisms of reciprocity based on verbal commitment and the threat of sanctioning, to play a leading role. Research on regular farmer members has shown that sanctioning and

[13] The reason is that the price offered by middlemen depends on the price that the farmer group secures ("yardstick effect"), which itself crucially depends on volume. Some groups manage to overcome this tension between private and group interests, while many others fail.

[14] A detailed description of the sampling scheme can be found in the online appendix, along with additional information in the research implementation.

[15] Only 1,097 of the subjects interviewed participated in the BGs. This gap arises because the experiments were conducted, in each DC, on a single day in a central location; to reduce attrition, interviewers returned to villages several times to locate members who were not present during the main day of data collection.

leader's legitimacy play an important role in explaining cooperation rates (Grossman and Baldassarri 2012). While regular members do not maintain stable relationships with each other, nor do they participate directly in the activity of the council, the subjects of the current analysis are active members of the DC councils and experience repeated interaction with other members of the farmer group on a regular basis; thus, they may have developed mechanisms of reciprocity based on verbal commitments. The small size of DC councils may also enhance the capacity of direct communication and even make it more effective than sanctioning (Ostrom 2010).

In addition, given their commitment to represent their villages in the farmer cooperatives meetings, one can also expect that they have developed a meaningful identification with the farmer organization, which could lead to greater group solidarity. Instead, we should not expect generalized altruism to be an explanation for different rates of cooperation across farmer cooperatives. In fact, on the basis of the information collected at the regional and farmer group levels, there is no reason to believe that cooperative types are differently distributed across villages nor that they would join the farmer groups at different rates. In other words, in the absence of specific selection processes, generalized altruism should not make a difference at the group level. However, I do not exclude this possibility a priori; thus I included experimental measures of generalized altruism in the data collection, and I control for levels of generalized altruism in the analyses.

RESULTS

The first step of the analysis is to establish a positive relationship, based on observational data, between social network position and cooperation. I then use lab-in-the-field experiments to distinguish different mechanisms (i.e., generalized altruism, group solidarity, reciprocity, threat of sanctioning) that might account for the relationship between networks and collective outcomes. Finally, I relate individuals' behavior in the BG to their level of cooperation in real life to identify which mechanism is more likely to account for differences in levels of cooperation.

Social Networks and Cooperation in the Producer Organization

Theories of collective action and social capital both suggest a relationship between social network structure and collective outcomes. In particular, network centralization and nonredundancy of network ties are considered to be network properties important for the provision of public goods (Gould 1993; Marwell and Oliver 1993; Burt 2004).

In each of the 50 farmer organizations, I collected complete network information on the relationships among members of the DC council. Each

member of the council was presented with the complete list of other members' names and, for each of them, was asked whether they speak frequently, consider alter a close friend, have his or her phone number, and go to him or her for advice.[16] For descriptive purposes, figure 1 reports the network structure of the advice network for six DCs.

For each of the four network relationships—speak, friendship, phone, advice—I consider four network measures: degree centrality, betweenness centrality, eigenvector centrality, and Burt's constraint. Degree centrality, or "total degree," is the simple count of in- and out-ties and is usually considered as a basic measure of ego's centrality, or popularity. Betweenness centrality is based on geodesic distance and captures the extent to which ego is instrumental in connecting otherwise disconnected alters, thus facilitating the flow of information and communication (Freeman 1979). Eigenvector centrality instead takes into account not only ego's degree but also the centrality of the people connected to him or her and is commonly interpreted as a measure of prestige (Bonacich 1972).[17] Finally, Burt's constraint captures the extent to which individuals are embedded in redundant relationships, thus constraining their capacity to reach out to a large set of alters. Burt's constraint is higher if ego has fewer or mutually related (i.e., more redundant) ties (Burt 2004).[18] In general, my expectation is that the more central actors are in the farmer network, the more likely they will be to participate in the life of the farmer cooperative.[19] In contrast, high levels of constraint should lead to less cooperation, since individuals find themselves embedded in a limited set of relations.

While most studies connecting network features to collective outcomes rely on a single network, in this case I test this relationship on individual-level observations coming from 50 different networks, thus making the findings more robust. We should, however, keep in mind that this part of

[16] The questions for each of these are as follows: "Do you speak to [NAME] on a regular basis?" "Is [NAME] a close friend or do you just know him or her? By close friend, I mean that you (a) eat together regularly; (b) you can leave your child with him or her if you need to travel for several days; and (c) he or she will help you in case of a family death." "Do you have [NAME]'s phone number?" "In the past 12 months, have you asked [NAME] for information or advice on matters related to the farmer association?"

[17] The eigenvector centrality of a node is its corresponding entry in the eigenvector associated with the largest eigenvalue of an adjacency matrix. While measures of centrality based on degree weight every contact equally, eigenvector centrality weights links according to their centralities. Eigenvector centrality can be conceived as a weighted sum of both direct and indirect connections and is a measure that takes into account the entire network structure.

[18] Other measures have been considered, such as in-degree, out-degree, closeness, clustering coefficient, etc., and they lead to results that are similar to those presented here.

[19] I used three different measures of centrality in order to assess the robustness of the results.

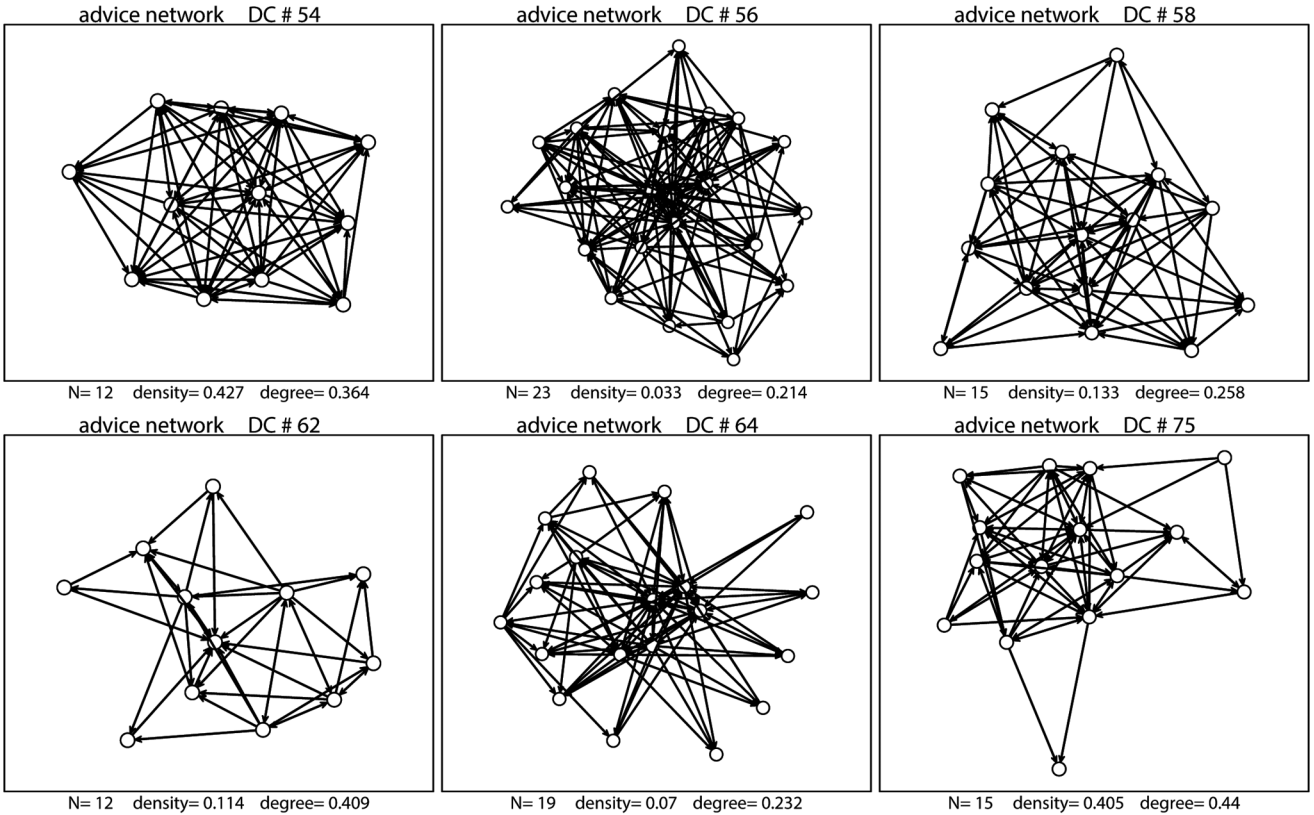

FIG. 1.—Example of advice networks in six DCs

the analysis is strictly descriptive. And since the network data have been collected at the same time as the outcome variables, we should also acknowledge the possible existence of a feedback loop: while, on the one hand, social relationships facilitate the emergence of cooperation, on the other hand, the experience of cooperation is likely to strengthen social relationships. The two effects cannot be decoupled with the data at my disposal, although there are reasons to believe that the latter is less pronounced.

There are two key collective outcomes that are particularly relevant for the life of the farmer organizations. The most important is the extent to which members sell their coffee through the producer organization.[20] On average, 70% of the members sold their coffee in bulk. There is, however, a fair amount of variation across DCs. In some producer organizations only a mere 10% of the members sell in bulk; in others, almost all of them rely on the producer organization. Our second measure concerns farmer participation in the life of the producer organization. In particular, we consider whether they attended the last general assembly. On average, almost three-fourths of the members attended the assembly.[21] The correlation between these two measures is .23 ($P = .030$), suggesting that they are related but likely to capture different facets of cooperation in the farmer group.

I model the relationship between network position and cooperation using multilevel logistic regressions (varying-intercept models) in which individuals are nested within producer organizations (DC), and the probability of (a) of selling via farmer group and (b) participating in the general assembly is estimated as a function of network position, controlling for individual-level characteristics, such as wealth, education, gender, age, and church attendance.[22]

Figure 2 shows the percentage change in the probability of selling via farmer group (panel A) and participating in the general assembly (panel B) as a function of a 1-SD change in the network measure for every type of network.[23] Results show, for instance, that a 1-SD increase in betweenness centrality in the friendship network is related to a 4.5% (confidence interval

[20] Here I use a binary variable. Similar results are obtained using the proportion of the crop that is sold in bulk.

[21] Among regular members, 61% sell in bulk, and 57% attended the last general assembly. Thus, the behavior of the farmer representatives is slightly more "virtuous" than that of regular members, but not dramatically more so.

[22] Formally,

$$\log\left[\frac{P(\text{selling via group})}{P(\text{side selling})}\right] = \mu_0 + \beta_1 \times \text{Network Measure} + \beta_2 \times \text{Individual Controls} + \varepsilon_i + \varepsilon_{DC}.$$

[23] For instance, considering the total degree measure, 1 SD corresponds, approximately, to 13 ties in the friend, speak, and advice networks and to seven ties in the phone network.

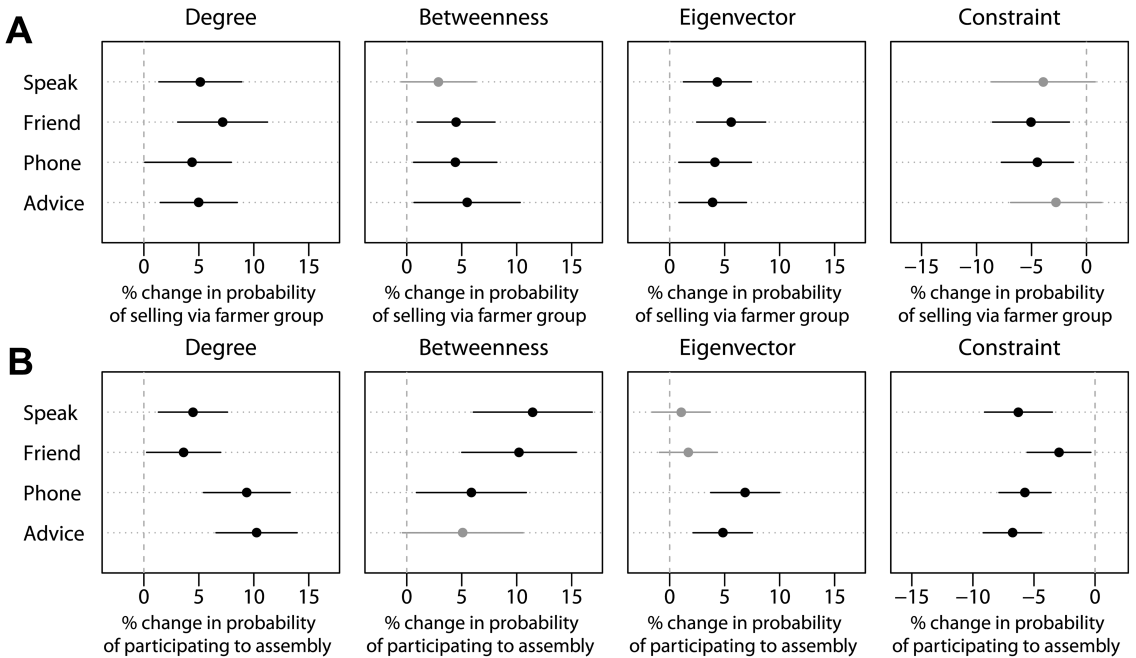

FIG. 2.—Relationship between position in the farmer network and cooperation. Percentage change in the probability of selling in bulk (panel *A*) and attending the general assembly (panel *B*) as a function of a 1-SD change in the corresponding network measure. Black plots indicate significant coefficients; 95% CI.

[CI] 1–8) increase in the probability of selling one's coffee through the farmer association and a 10.2% (CI 5–15.4) increase in the probability of attending the general assembly. In general, the results show that greater network centrality, in terms of number of ties, betweenness, and prestige, is associated with greater chances of cooperation, both with respect to selling in bulk and participating in the group activities, while having redundant ties is associated with a lower likelihood of cooperation. Individuals who span across a larger portion of the cooperative networks are more likely to bypass free-rider opportunities and contribute to public goods production.

Measuring Mechanisms with Lab-in-the-Field Experiments

Having assessed the relationship between social network position and cooperation, I turn now to consider the different mechanisms that might account for such a relationship. Local producers took part in lab-in-the-field BGs through which I measured their level of prosocial behavior, distinguishing between generalized altruism and group solidarity, and their cooperation propensity, distinguishing between a reciprocity mechanism based on communication and the threat of sanctioning.

As described in the previous section, the DG is traditionally used to measure other-regarding behavior, as participants decide under conditions of anonymity and are not exposed to the risk of sanctioning or loss of reputation. The basic version of the DG, in which deciders have to divide the endowment between themselves and a stranger, is commonly used as a measure of generalized altruism, while versions of the DG in which the identity of the recipient is specified (e.g., ethnicity, gender) have been used to measure prosocial behavior toward specific groups (Camerer 2003; Whitt and Wilson 2007; Adida et al. 2010). In my lab-in-the-field DG, each farmer group member was invited to divide two endowments between herself or himself and two different alters, whose specific identity was to remain unknown. Each endowment was 10 coins of 100 Ugandan shillings (10 monetary units, MUs), which are equivalent to half a day's wage in rural Uganda.

In each of the 50 farmer groups, half of the participants were randomly assigned to an experimental variant in which participants had to divide a first endowment between themselves and a stranger and a second endowment between themselves and another member of the producer organization. The scenario in which people give to a stranger provides a measure of *generalized altruism*, while the scenario in which the recipient is a member of the producer association constitutes a measure of *group solidarity*. The expectation is, of course, that individuals would give more to a member of their group than to a stranger.

However, the difference between the contribution to a stranger and the contribution to a group member might not necessarily be due to group

solidarity per se; rather, it might simply reflect the fact that the social distance between giver and receiver is much smaller in the case of a group member than a stranger. To consider this possibility, the other half of the participants were assigned to a second variant of the DG, in which deciders divided their endowment with a stranger and, differently from the first variant, with someone from their village.[24] Overall, the familiarity and frequency of interaction with covillagers are similar to those with members of the farmer group.[25] If membership in the farmer organization has triggered a strong sense of group attachment, we would expect our subjects to show greater solidarity toward comembers than to covillagers (see online app. III for the DG script).

Figure 3 reports results for both variants of the DG. Confirming previous scholarship, respondents give, on average, almost 30% of their endowment to a stranger. More interestingly, compared to their contribution to strangers, group members give half a coin more to a covillager (0.48 MU; $P < .001$) and more than a coin to another member of the producer organization (1.12 MUs; $P < .001$). Changing the identity of the recipient, namely, moving from a generalized other to a member of the in-group, increases contributions. Moreover, group members give 0.64 MU more to a comember than to a covillager ($P < .001$), thus confirming the expectation that group solidarity among members of the farmer organization is triggered by a sense of attachment to the group that goes beyond mere familiarity with or exposure to the other members, as might be the case with covillagers. Table A1 in the appendix reports results for the estimation of the average treatment effect in tabular form as obtained from a three-level random intercept linear regression model that controls for group and interviewers' effects.

The emergence of cooperation over repeated interaction is traditionally captured using PGGs. Accordingly, I run a lab-in-the-field PGG in order to assess the extent to which reciprocity through communication and the threat of sanctioning are mechanisms that affect farmer groups' cooperative capacity.[26] All farmer group members participated in six rounds of a PGG. In each round, they were endowed with 10 MUs and had to decide how much to keep for themselves and how much to put in a common pot, whose content would be doubled and redistributed equally among the

[24] I also randomized the order in which subjects were confronted with the choices, asking half of the subjects to first allocate the endowment to a stranger and then to a comember or covillager and asking the other half to allocate first to a comember or covillager and then to a stranger. The order in which the choice was made does not influence the results.

[25] See Baldassarri and Grossman (2013) for further details on this aspect.

[26] While there are previous instances of lab-in-the-field DGs, to my knowledge this is the first research in which a PGG has been performed in the field.

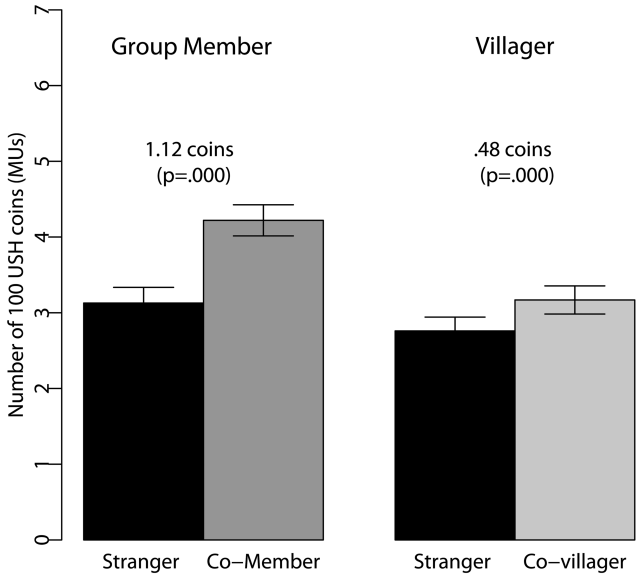

FIG. 3.—Average contribution to a stranger and a member of the in-group in a DG. Participants in a DG give 1.12 MUs more to members of their producer organizations (dark gray bar) and only 0.48 MU more to covillagers (light gray bar) than to strangers (black bars), suggesting that group attachment, and not only familiarity with the in-group, triggers prosocial behavior. Average treatment effects are estimated using multilevel models as described in appendix table A1.

participants. In each producer organization, group members were randomly assigned to one of three variants of the PGG. In the baseline condition, subjects participated in six rounds of a PGG without punishment or communication. In the second condition, after two preliminary rounds of play, one of the participants was elected to become a monitor endowed with sanctioning power. Namely, monitors were able to spend 1 MU to take away 3 MUs from subjects whose contribution level they disapproved.[27] In the third condition, after two preliminary rounds of play, players were allowed to publicly discuss their strategy for three minutes. This communication took place at the end of every successive round (see online appendix for the PGG script).

This setting allows for the assessment of the causal effect of communication and sanctioning on levels of cooperation. Figure 4 reports the trend in the average contribution to the public good for each of the three vari-

[27] Monitors received the same endowment as the other subjects but could not contribute to the PGG or receive part of the common endowment. See Baldassarri and Grossman (2011) for additional information on the game.

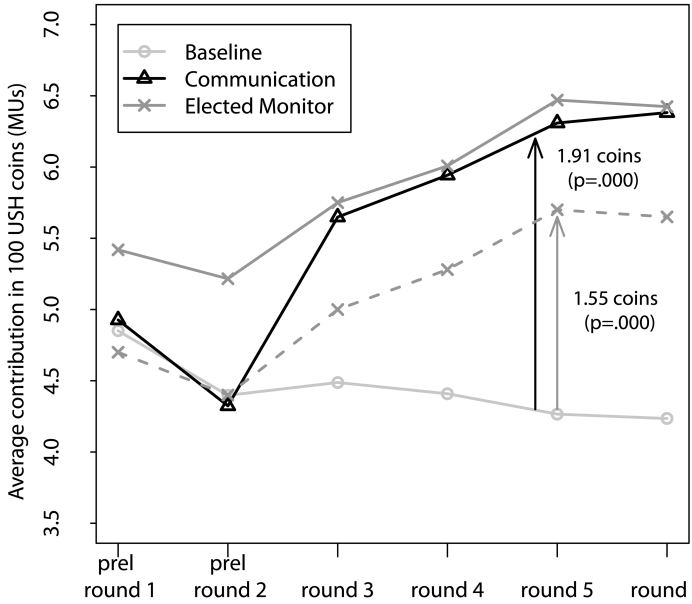

FIG. 4.—Average contribution in the PGG. Solid lines report the observed trend for the baseline (light gray line), communication (black line), and sanctioning (dark gray line) conditions. The dashed line reproduces a fictional trend that could be expected under optimal experimental conditions. The average difference in contributions between communication and the baseline condition is 1.91 MUs, while the difference between sanctioning and the baseline is 1.55 MUs. Estimates come from multilevel models reported in appendix table A2.

ants. Solid lines report the observed trend for the baseline (light gray line), communication (black line), and sanctioning (dark gray line) conditions. According to our research design, we would expect no differences between variants in the first two preliminary rounds. This is the case for the baseline and communication variants in which subjects contributed between 45% and 50% of their endowment. Unfortunately, as a result of an interviewer effect, subjects in the monitor condition contributed between 5% and 8% more in the two preliminary rounds, and this difference is marginally significant.[28] To control for this aspect, I rely on results from multilevel models that control, among the other things, for the interviewers and the contribution in the preliminary rounds. The dashed line reproduces a fictional

[28] Since small deviations from a BG script can lead to substantial variations in the game outcomes, interviewers were instructed to follow the game script closely. However, two interviewers who served mainly in the PGG monitor variant slipped into the description of the game some encouragement that led participants to contribute more.

trend that could be expected under optimal experimental conditions. Table A2 in the appendix reports the modeling strategy and results in greater detail.

Results show that in the baseline condition, in which subjects participate in multiple rounds of the PGG without any type of interaction, contributions decline by almost 10%, in line with previous experiments. In contrast, when participants were allowed to communicate, there is a visible increase in contributions: on average, the contribution in the communication condition is 1.91 MUs higher ($P < .001$) than in the baseline condition. Repeated interaction supported by communication is therefore effective in triggering mechanisms of reciprocity and increases the overall level of cooperation. Although less effective, the threat of punishment leads to similar results. Subjects in the sanctioning condition tend to give, on average, 1.55 MUs more than subjects in the baseline condition ($P < .001$).

Overall, I conclude that various mechanisms could be the basis of farmer group members' prosocial behavior and cooperative capacity. As in many other studies, I have found that subjects display altruistic behavior toward strangers. I also found that giving to a member of one's farmer organization leads to significantly greater donations, suggesting the existence of a mechanism of group solidarity. Moreover, in iterated strategic interactions, the threat of sanctioning increases the likelihood of cooperation. Finally, communication between participants is sufficient to elicit mechanisms of reciprocity, even in the absence of binding agreements, or the threat of sanctioning.

According to my research design, BGs are deployed in order to elicit mechanisms that are at work in real life and, specifically, the mechanisms that are responsible for inducing greater cooperation in the producer organization. It is now time to ask to what extent, if any, behavior in the experimental setting maps into our subjects' behavior in real life. Are more altruistic farmers or those who show greater attachment to the group also more likely to cooperate? Or instead do mechanisms of reciprocity and sanctioning lead to greater cooperation among farmer producers?

Cooperation in the Lab and in Real Life

The last step in the analysis connects prosocial behavior in the experimental setting to levels of cooperation in the farmer group. The assumption driving this analysis is that whenever we find a correlation between behavior in the BGs and behavior in the farmer group, we can reasonably infer that the mechanisms that were isolated in the experimental setting might be at the basis of real-world outcomes (Poteete et al. 2010).

Figure 5 presents results from multilevel logistic regression models in which the two measures of collective outcome introduced before, namely,

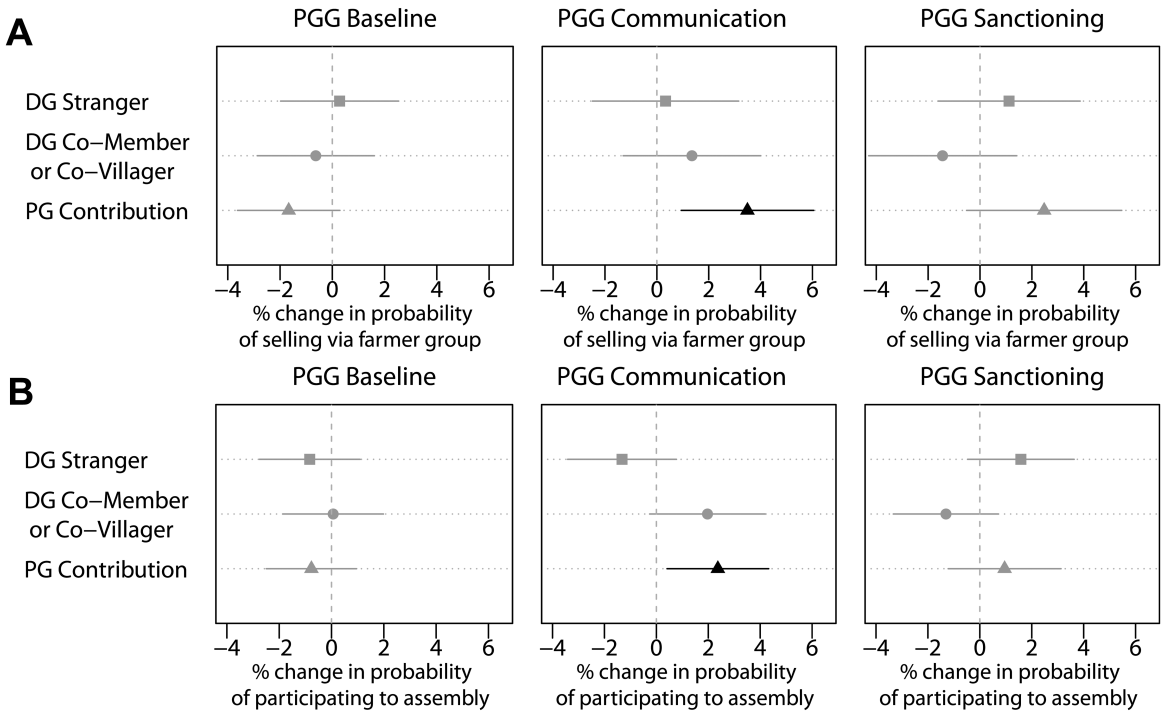

FIG. 5.—Relationship between behavior in BGs and cooperation in the producer organization. Percentage change in the probability of selling in bulk (panel *A*) and attending the general assembly (panel *B*) as a function of a 1 MU change in the corresponding BG. Appendix tables A3 and A4 report these results in tabular form. Black plots for significant coefficients; 90% CI.

whether farmers sold their coffee through the producer organization (panel *A*) and whether they attended the last general assembly (panel *B*), are modeled as a function of individuals' behavior in BGs, controlling for individual- and group-level predictors (as in previous models). Since subjects were assigned to different variants of the BGs, it is necessary to compute separate models for each variant. For instance, the left plot of panel *A* reports the percentage change in the probability of selling in bulk as a function of a 1 MU change in the contribution to a stranger, to a comember, or to a covillager and average contribution (in rounds 3–6) in the baseline condition of the PGG game.[29] The center plot shows the same analysis for those subjects that were assigned to the communication condition in the PGG, and the right plot reports results for those assigned to the sanctioning condition. Tables A3 and A4 in the appendix report results for these models in tabular form.

Findings suggest that neither generalized altruism, as measured by the contribution to a stranger, nor group solidarity, as measured by the contribution to a member of the producer organization (or village), is a good predictor of whether group members will sell in bulk. In contrast, subjects' reciprocity in an experimental setting is predictive of their behavior in the farmer group. In particular, those subjects who were more likely to cooperate in the PGG with communication were also more likely to sell via their farmer group: a 1 MU increase in contribution in the communication variant of the PGG corresponds to a 3.5% increase in the likelihood of selling via the farmer group ($P = .024$).[30] The corresponding figure for the baseline variant of the PGG is -1.7% ($P = .161$) and for the sanctioning variant is 2.5% ($P = .174$). The last two, however, do not meet minimal criteria for statistical significance.

A similar pattern can be observed with respect to the likelihood of attending the general assembly (fig. 5, panel *B*). The only mechanism that is significantly correlated with participation in the life of the farmer organization is reciprocity: individuals who were more cooperative in the PGG with communication were also more likely to have attended the group meeting. A 1 MU increase in the contribution in the communication variant of the PGG corresponds to a 1.9% increase in the probability of attending the

[29] I have collapsed the two variants of the DG in this analysis in order to have a larger sample size and improve the quality of the estimates. Considering the distinction between the two types of recipients in the DG does not lead to substantively different results.

[30] Although not particularly large, the magnitude of the effect is not trivial. Moreover, no sociodemographic predictor, when controlling for the level of contribution in behavioral games, is consistently significant (see app. tables A3 and A4). In a model that includes only sociodemographic predictors, namely, gender, age, education, religiosity, and wealth, the latter is the only significant predictor of selling in bulk, and its estimated effect is smaller than the one reported for the contribution in the PGG with communication: a unit change in the standardized measure of wealth corresponds to a 3.3% increase in the likelihood of selling via the farmer group ($P = .025$).

general assembly ($P = .086$). Once again, the corresponding figure for the sanctioning variant of the PGG is only slightly smaller in magnitude (1.4%) but nonsignificant ($P = .317$).

In sum, of the different mechanisms considered, reciprocity is the one that stands out as being significantly correlated with cooperation in real life. Although results from this part of the analysis cannot be considered conclusive because of the sample size (the number of observations ranges from 197 to 370, depending on the model), similar analyses conducted on a representative sample of regular members (who are not members of the DC council) confirm that levels of generalized altruism and group solidarity are not related to cooperation in the farmer group.[31] While among regular farmers sanctioning and the legitimacy of the group leadership are positively related to levels of cooperation (Grossman and Baldassarri 2012),[32] among members of the DC council, verbal communication turns out as the most viable solution to collective action dilemmas. In line with findings from research on common-pool resources, in small groups with a sufficient level of commitment, face-to-face interaction can be even more effective than sanctioning in overcoming free-rider problems (Ostrom et al. 1992; Ostrom 2000).

DISCUSSION

The study of the noncontractual preconditions of economic exchanges and, in more general terms, the embeddedness of markets in social life has been at the center of sociologists' and economic historians' understanding of economic life for centuries (Weber [1905] 1930; Polanyi 1944; Granovetter 1985; Greif 1993; Uzzi 1996; Burt 2005). In this research I have focused on the establishment of a novel market institution—the producer organization—to understand how local producers in development countries solve classic problems of collective action. This setting has provided a vantage point to test theories of social networks, collective action, and social capital through an innovative research design.

Extant theories widely recognize the role of repeated interaction and social networks in bringing about cooperation. Accordingly, my analysis confirms that individuals who occupy more central positions and those who are better able to span a large portion of the organization network tend to participate more in the production of public goods. The novelty of my contribution consists in going beyond the empirical assessment of this rela-

[31] Results are available from the author.

[32] Regular farmers did not participate in the communication version of the PGG because the experience of repeated interaction with other farmer group members is not as diffused among them as it is among village representatives to the DC council.

tionship, to identify the specific mechanisms that bring about cooperation in a specific social setting. Considering both the motives actors have for cooperation and the beliefs they hold about others' behavior, I have identified four general mechanisms—generalized altruism, group solidarity, reciprocity based on verbal commitment, and the threat of sanctioning—and proceeded to test their effectiveness using behavioral games.

Namely, I took behavioral games out of the aseptic walls of the laboratory and brought them to the field. By adopting an innovative methodological framework that combines behavioral games, network data, and survey interviews with members of Ugandan producer organizations, I was able to isolate the mechanisms that make group members cooperate in real life. This research design fulfills sociology's important aspiration, recently revived under the label of analytical sociology, to move beyond the simple assessment of correlations to investigate the mechanisms that bring about important social phenomena (Merton 1957; Gambetta 1988; Hedström 2005; Hedström and Bearman 2009). To my knowledge, this article is the first to use lab-in-the-field experiments to achieve this purpose. The payoff, I believe, is substantial.

Through a novel adaptation of the DG and PGG in which members of the farmer organizations were randomly assigned to different game variants, I was able to demonstrate that, in our population of interest, group attachment leads to levels of solidarity toward members of the group that are substantially higher than general levels of altruism toward strangers and toward nonmembers and that both mechanisms of reciprocity and the threat of sanctioning lead to greater public goods provision. This experimental component allows us to decouple these different mechanisms and to draw causal conclusions about their effects in the population of interest.

The value added of carrying out behavioral experiments in a field setting is the capacity to relate behavior observed in the "real" setting to the mechanisms captured in the controlled experimental setting. In this analytical framework, the lab-in-the-field experiment is therefore used as a "petri dish" in order to isolate the mechanisms that are likely to be at work in real life. In particular, the experimental design makes it possible to conclude that the relationship between BGs and real-life behavior is not due to unobserved heterogeneity. Since, within each producer organization, participants have been randomized to different BGs variants, we can exclude that the relationship between BGs and real-life behavior is spurious and is brought about by some unobserved factors. However, we cannot exclude that some other, independent mechanisms is also to work.

In the context of producer organizations, other-regarding preferences, in the form of either generalized altruism or group solidarity, do not seem to be the motivations that trigger cooperation among local farmers. Rather, reciprocity emerging through communication is the mechanism most strongly

related to cooperation in the producer organization. I conclude from this that sustained interaction and verbal commitment are therefore sufficient conditions, in this context, for making cooperation convenient and discouraging free riding. Finally, among the farmer representatives object of this study, the threat of sanctioning, although effective in an experimental setting, does not appear to be the mechanism at the basis of cooperation in real life.[33] Given the economic nature of these producer organizations, the finding that cooperation is likely to emerge from strategic considerations, rather than altruistic motivations, may not be particularly surprising. However, as suggested in the discussion of the scope conditions of the various collective action theories, I do expect a similar research design to lead to different conclusions if we were to consider other types of groups facing collective action problems. For instance, in the context of political mobilization or high-risk activism, I expect that prosocial motivations, and group solidarity in particular, would play a more important role; in the context of large groups, with sparse networks and rare social interactions, I expect the threat of sanctioning to be more effective than reciprocity. In sum, this approach can be applied to different instances of public goods provision, thus allowing for an assessment of the scope conditions of our theories of collective action and social capital.

A systematic comparison of the different mechanisms that bring about cooperation should benefit the literature on collective action, which has developed a rich emporium of such mechanisms but has not yet developed a systematic way to assess between them empirically. Greater focus on the motivations and strategic considerations that favor cooperation among interconnected actors will also greatly advance the literature on social capital. The latter, in fact, often relies on the general assumption that social networks and associational life have a positive impact on individual and group outcomes but rarely goes beyond the use of attitudinal measures of trust or self-reported measures of social relations and rarely makes any serious attempt at documenting the specific mechanisms through which social relations bring about trusting and cooperative behavior. This, however, is of utmost importance in fields such as economic development, in which social capital scholarship can inform policy interventions and therefore has the potential of affecting the life outcomes of individuals and their communities. While for academic scholarship observing a relationship between networks and outcomes might suffice, to devise effective social interventions, it is important to know the motivations, strategies, and incentives that affect the behavior of interconnected actors in specific settings.

[33] Since, within each farmer cooperative, participants have been randomized to different variants of the treatment, we can exclude that the relation between BG and real-life behavior is spurious and is brought about by some unobserved factors. However, we cannot exclude that some alternative mechanism exists.

Finally, social network research could find an important ally in behavioral games to advance its research agenda, moving beyond demonstrations that network position and overall network structure "matter" to better assess the motivations, patterns of strategic interaction, and group dynamics that inform individual and group behavior. While in the research here presented network data have been used exclusively to show the existence of a positive relationship between network position and cooperation, preexistent social relations can be incorporated in lab-in-the-field research designs, thus systematically subjecting network measures of interest to experimental variation. Along with the study of network evolution, which in certain cases may be unfeasible, network-based lab-in-the-field experiments can facilitate the causal assessment of network effects in specific social settings.

APPENDIX

TABLE A1
AVERAGE TREATMENT EFFECT OF THE DICTATOR GAME EXPERIMENT

	β	SE
Average treatment effect (comember vs. covillager)	.880***	.17
Stranger	−.554***	.03
Male	.158	.16
Age (units of 10)	−.034	.05
Church attendance	.127	.12
Education (std.)	−.104	.07
Wealth (std.)	.01	.07
Intercept	1.66***	.47
$\sqrt{\psi_{(a)}}$	−.91**	.42
$\sqrt{\psi_{(b)}}$	−.35**	.16
σ_e	.53***	.03
Log likelihood	−1,697	
N	839	

NOTE.—The dependent variable is the difference in the contribution to group/village members and strangers. The table reports results from a three-level random intercept linear regression model, in which individuals are nested within producer organizations and interviewers, in order to control for group and interviewer effects. The expression $\sqrt{\psi_{(a)}}$ refers to variability between farmer groups; $\sqrt{\psi_{(b)}}$ refers to between-interviewers variability; and σ_e is the estimated SD of the overall error term.

* $P < .05$.

** $P < .01$.

*** $P < .001$.

TABLE A2

AVERAGE TREATMENT EFFECT OF THE PUBLIC GOODS GAME EXPERIMENT

	COMMUNICATION: BASELINE		MONITOR: BASELINE		COMMUNICATION: MONITOR	
	(1)	(2)	(1)	(2)	(1)	(2)
Average treatment effect	191.39***	191.08***	162.26***	155.10***	−2.36	−10.11
	(17.10)	(18.18)	(18.94)	(20.31)	(21.87)	(22.88)
Round $t - 1$	3.81	3.89	2.51	3.23	24.60***	25.95***
	(3.72)	(3.94)	(3.70)	(3.94)	(3.94)	(4.18)
No. subjects per session	10.02	10.26	−2.12	−1.64	.73	2.25
	(8.58)	(8.97)	(8.45)	(8.99)	(10.55)	(10.96)
Preliminary contribution	.52***	.51***	.49***	.49***	.42***	.40***
	(.03)	(.03)	(.03)	(.03)	(.03)	(.03)
Male		9.25		−12.12		−22.35
		(20.37)		(19.17)		(23.03)
Age (units of 10)		10.63		1.917		8.89
		(7.09)		(6.54)		(8.19)
Church attendance		−2.98		7.53		−7.25
		(16.37)		(14.76)		(18.64)
Education (std.)		15.24*		2.55		9.44
		(8.64)		(7.96)		(10.57)
Wealth (std.)		−17.25*		.80		−4.17
		(9.37)		(8.97)		(11.21)
Intercept	83.87	41.35	222.26**	196.29*	290.94***	284.25**
	(88.02)	(109.79)	(87.03)	(106.46)	(104.23)	(124.61)
$\sqrt{\psi_{(3)}}$	4.48***	4.52***	4.49***	4.55***	4.61***	4.63***
	(.15)	(.15)	(.15)	(.14)	(.16)	(.16)
$\sqrt{\psi_{(2)}}$	5.01***	4.99***	4.82***	4.80***	4.99***	4.97***
	(.06)	(.07)	(.08)	(.10)	(.07)	(.07)
σ_e	5.37***	5.37***	5.35***	5.36***	5.25***	5.26***
	(.02)	(.03)	(.03)	(.03)	(.03)	(.03)
Log likelihood	−19,373	−17,478	−18,484	−16,734	−13,492	−12,109
N	2,816	2,544	2,712	2,456	1,992	1,792

NOTE.—Average treatment effect of different variants of the PPGs. The dependent variable is PGG contribution in round t, considering rounds 3–6. The table reports results from a series of three-level random intercept models, in which contributions in round t (level 1) are nested within individuals (level 2), who themselves are nested within producer organizations (level 3). Communication: baseline refers to the the average treatment effects (ATE) of communication compared to the baseline, monitor: baseline refers to the the ATE of the elected monitor compared to the baseline, and communication: monitor refers to the the ATE of communication compared to the elected monitor; $\sqrt{\psi_{(2)}}$ refers to between-subjects variability, $\sqrt{\psi_{(3)}}$ refers to variability between farmer groups, and σ_e is the estimated standard deviation of the overall error term. Given the panel setup, the multilevel regression models further assume that the errors have an autoregressive structure of order 1. Numbers in parentheses are SEs.

* $P < .05$.

** $P < .01$.

*** $P < .001$.

TABLE A3

Relationship between Contribution in BGs and Selling in Bulk

	PG Baseline		PG Communication		PG Sanctioning	
	(1)	(2)	(1)	(2)	(1)	(2)
PG contribution	−.09	−.09	.17*	.19*	.19	.16
	(.06)	(.06)	(.08)	(.09)	(.12)	(.12)
Preliminary contribution	−.00	−.00	−.14^{+}	−.14^{+}	−.012	.02
	(.06)	(.06)	(.07)	(.08)	(.09)	(.09)
DG stranger	.01	.02	.01	.02	.08	.07
	(.07)	(.07)	(.09)	(.10)	(.11)	(.11)
DG comember/villager	−.02	−.03	.09	.08	−.09	−.10
	(.07)	(.07)	(.09)	(.09)	(.11)	(.12)
Male		.14		.60		−.84
		(.33)		(.44)		(.57)
Age (units of 10)		.03		−.30^{+}		.04
		(.12)		(.16)		(.17)
Church attendance		−.19		−.26		.13
		(.26)		(.36)		(.37)
Education (std.)		−.20		−.32		.37^{+}
		(.14)		(.24)		(.22)
Wealth (std.)		−.01		.17		.32
		(.15)		(.21)		(.28)
Intercept	1.53*	1.88^{+}	.22	1.90	.49	.67
	(.37)	(1.05)	(.57)	(1.52)	(.77)	(1.49)
$\sqrt{\psi}$	−.16	−.12	−.12	−.024	.182	.17
	(.24)	(.25)	(.32)	(.31)	(.29)	(.29)
Log likelihood	−208	−2-04	−121	−117	−101	−98
N	365	362	214	213	197	197

Note.—The dependent variable is selling in bulk vs. side selling. Multilevel logistic regressions (varying intercept models) model individuals nested within producer organizations. The expression $\sqrt{\psi}$ refers to variability between producer organizations. Numbers in parentheses are SEs.

$^{+}$ $P < .10$.

* $P < .05$.

** $P < .01$.

TABLE A4

Relationship between Contribution in BGs and Attending the General Assembly

	PG Baseline		PG Communication		PG Sanctioning	
	(1)	(2)	(1)	(2)	(1)	(2)
PG contribution	−.05	−.08	.21^{+}	.17	.09	.13
	(.07)	(.07)	(.10)	(.10)	(.13)	(.13)
Preliminary contribution	.07	.09	−.15	−.11	.08	.06
	(.06)	(.07)	(.09)	(.09)	(.10)	(.11)
DG stranger	−.06	−.04	−.12	−.11	.15	.14
	(.08)	(.08)	(.11)	(.12)	(.12)	(.12)
DG comember/villager	.00	.00	.17	.19	−.13	−.10
	(.08)	(.08)	(.12)	(.12)	(.12)	(.12)

TABLE A4 (*Continued*)

	PG Baseline		PG Communication		PG Sanctioning	
	(1)	(2)	(1)	(2)	(1)	(2)
Male		1.17**		.53		.38
		(.33)		(.50)		(.54)
Age (units of 10)		−.04		.24		−.01
		(.12)		(.20)		(.21)
Church attendance		.14		−.33		.24
		(.28)		(.48)		(.42)
Education (std.)		.27		.55*		.35
		(.14)		(.24)		(.23)
Wealth (std.)		−.11		−.40		−.04
		(.16)		(.25)		(.28)
Intercept	1.55**	.44	1.00	.44	1.13	.00
	(.40)	(1.07)	(.65)	(1.81)	(.77)	(1.60)
$\sqrt{\Psi}$	−.22	−.24	.018	−.04	−.34	−.58
	(.29)	(.31)	(.33)	(.35)	(.60)	(.87)
Log likelihood	−186	−177	−91	−87	−76	−74
N	370	367	218	217	199	199

NOTE.—The dependent variable is attending vs. not attending the general assembly. Multilevel logistic regressions (varying intercept models) model individuals nested within producer organizations. The expression $\sqrt{\Psi}$ refers to variability between producer organizations. Numbers in parentheses are SEs.

$^{+}$ $P < .10$.

* $P < .05$.

** $P < .01$.

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