Ties that bind: network redistributive pressure and economic decisions in village economies

Ties that Bind: Network Redistributive Pressure and Economic Decisions in Village Economies[+]

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Abstract

In this paper, we identify some of the economic implications of the pressure to share resources within a social network. Through a set of field experiments in rural Tanzania we randomly increased the expected harvest of the treatment group by the assignment of an improved and much more productive variety of maize. We find that treated individuals reduced the interaction with their village network that entails revealing their seeds type. We also find that treated individuals reduced labor input by asking fewer network members to work on their farm during the growing season and, as a result, obtained fewer harvest gains.

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Keywords: Networks, Field Experiment, Social Norms, Redistributive pressure, Harvest, Tanzania

JEL: O12, O13, C93, H26, Z13

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Abstract

In this paper, we identify some of the economic implications of the pressure to share resources within a social network. Through a set of field experiments in rural Tanzania we randomly increased the expected harvest of the treatment group by the assignment of an improved and much more productive variety of maize. We find that treated individuals reduced the interaction with their village network that entails revealing their seeds type. We also find that treated individuals reduced labor input by asking fewer network members to work on their farm during the growing season and, as a result, obtained fewer harvest gains.

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1 Introduction

Social networks – a key component of social capital – play an important role for the livelihood and development prospects of communities in the developing world.[1] They provide informal insurance and credit when markets are imperfect or absent (e.g. Udry, 1990; Rosenzweig, 1988; Fafchamps, 1992; Greif 1993, Coate and Ravallion, 1993; Townsend, 1994, Udry, 1994, Anderson and Baland, 2002, Ligon et al. 2002, Fafchamps and Lund, 2003; Kinnan and Townsend, 2012, Attanasio et. al., 2012), facilitate technology diffusion (Bandiera and Rasul, 2006; Conley and Udry, 2010) and provide opportunities for human capital investment and resource redistribution (Angelucci and De Giorgi, 2009; Angelucci et al., 2010).[2] One of the quintessential characteristics of social network relations is the social norm of sharing that is experienced by its members. The more successful members of the network must help the least successful members of the social network (Rosenzweig and Wolpin, 1994).[3] They may also be requested to contribute more to local public goods (Olken and Singhal, 2011). Resource redistribution within the network can, therefore, be characterized like an 'informal' redistributive tax (Platteau, 2000; Baland et al., 2011; Squires, 2016). And like a tax it may trigger an *evasive* response. This view is supported by recent experimental evidence (Jakiela and Ozier, 2016, Beekman et al. 2015; Boltz et al.; 2016).[4] An underexplored research question is to what extent this evasive response may correspond to ill-suited economic decisions. For

[1] See Durlauf and Fafchamps (2005) and Jackson (2008) for a review.

[2] Households' expectations of future assistance and transfers are key motivators behind participation in these networks. Other explanations such as altruism, guilt and potential social sanctions also seem to play an important role in shaping individual interactions in networks (Platteau 2000, Foster and Rosenzweig 2001, Barr and Stein 2008, Leider et al., 2009, Alger and Weibull 2010, Ligon and Schechter, 2012).

[3] Scott (1975) and Platteau (1991) refer to the concept of the 'moral economy.' Scott (1985) – cited in Platteau (2014) – noted that help to the poorer was less from a sense of liberality but from redistributive pressure.

[4] In the context of an experimental study of involuntary giving, similar findings have emerged. Dana et al. (2006), for instance, found that 28% of senders in a standard dictator game preferred to hide at a cost rather than to send nothing to the receivers.

instance, would individuals reduce economically profitable social interactions so as to prevent resource sharing with network members? In this paper, we aim to fill this gap by exploring the economic implications of a social network's redistributive pressure.

We designed a set of field experiments in rural Tanzania with the aim to explore a relation between social interactions and positive income shock. To create a positive income shock we exploited the differential productivity of maize seeds. We randomly assigned to a treatment group a more productive, improved variety of maize. The control group received and planted instead a traditional, lower yielding variety. According to agronomic trials in research stations improved varieties may produce yields up to five times larger than the traditional variety.[5] Improved maize thus substantially raises the expected harvest and so income of those receiving it. We tested if these subjects altered some dimensions of their interaction with their neighbors in the social network.[6] In rural Tanzania, like in many parts of the developing world, farming is usually a 'family' business. All members of a given household are involved in different farming activities (e.g., soil preparation, sowing, weeding, fertilizer application, harvesting, threshing) providing the labor source in the production process. Social networks, however, are an effective way of expanding labor. A typical example are labor sharing agreements within the social network under which a household head invites members of other households to support specific farming practices and activities. Using one's network, labor input in production processes is thus increased. The compensation in labor sharing agreements is typically, but not necessarily, a share of the output (Krishnan and Sciubba, 2009).

We find that the individuals in the treatment group, as compared to the control group, reduced

[5] A recent set of randomized controlled trials undertaken by CIMMYT in the framework of the Adoption Pathways 2013 Project has estimated a smaller productivity gain between 70 and 90 per cent.

[6] An alternative would have been to provide farmers with an unconditional cash transfer. Cash is, however, easier to conceal than seeds. This would have made the detection of potential evasive behavior more difficult. Moreover, hiding from the network comes with a cost (e.g., having less help in the farm). Our design allows us to capture both of these aspects.

the interaction with their village network that entails revealing their seeds type. They indeed reduced discussions concerning their seeds from the moment they receive them and made fewer labor sharing agreements afterwards.[7] We also find that the differences between the control and treatment group increases with the size of the network. We do not, however, find a similar pattern for other types of social interactions that do not imply direct visibility of one's seeds or crops (e.g. asking for information on general agricultural or land issues). We also find that the size of the network affects the quantity of maize harvested in the treatment group. More specifically, while the improved seed does increase yields, this beneficial effect declines as the number of network members rise. This effect of the increasing network size is not found for the control group with the traditional maize variety.

Our results contribute to two other broad strands of literature. The first is the small but expanding literature linking social networks to input misallocation (Banerjee and Munshi, 2004; Di Falco and Bulte, 2011; Baland et al. 2015; Squires, 2015; Munshi and Rosenzweig, 2016)... The second strand of related literature is on social pressure and involuntary giving (List and Lucking-Reiley, 2002; Dana et al. 2006; Landry et al., 2006; Dellavigna et al., 2012; Jakiela and Ozier, 2016, Squires, 2016). This paper confirms some of the key findings in this area (e.g., social pressure increases giving) by providing field evidence on social network redistributive pressure in the developing world.

The paper proceeds as follows. The next section provides a description of the data and the design of the field experiment. In Sections 3 and 4, we present and discuss the empirical strategy and the results. Then, in Section 5 we conclude the paper by offering some final remarks. In the Appendices we provide additional tables and a detailed description of the experimental setup.

[7] It should be stressed that the improved seeds do not require less labor. Hence the reduced interaction is not a result of a lower labor requirement. This issue is further addressed later on in the paper.

2 Setting, design and procedures

We conducted a set of field experiments in fifteen villages located in two maize growing areas of rural Tanzania, the South-East (Morogoro) and the North (Karatu). These villages may be thought as fairly isolated, self-contained, units as they are far from each other. Approximately 10 per cent of farmers in each village, a total of 314 farmers, took part in the experiments.[8] Working with a relatively small fraction of farmers per village is necessary to prevent the experimental activity becoming too disruptive of village life. It also reduces the likelihood of general equilibrium effects such as changes in local labor and maize markets.[9] People living in these areas are self-subsistence farmers with crops mostly consumed within the household and any surplus marketed. Table 1 describes the main characteristics of the farmers (and their farms) participating in the experiment. 148 farmers (47% of the sample) randomly received the improved seeds. The remaining 166 were randomly assigned to the control group (53% of the sample). The average network size of a household (e.g. degree) is 9.2 members within the village (with a minimum of 0 and a maximum of 33) and 5.7 members located in other villages. The average number of network members asked to enter into a labor sharing agreement during the last 12 months is 1.9 while the standard deviation is 2.8 with a maximum of 20. The average for the group with improved seeds is 1.7 while the average for the control group is 2.1.

The average household size is 4.95 (with a minimum of 1 and a maximum of 10) with the average head of the household 44 years old, of which 60% had some education. Some of the household heads in the sample are also village leaders (17%). Only 11% of the farm households' heads are female. The average farm size is 1.4 ha and 23% of households own an ox.

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[8] When we designed the experiment, we did a standard power calculation. Considering a significance level alpha of 0.05, 80 per cent power, an effect of half a standard deviation, and an estimated intra-cluster correlation of 0.036, we obtained a needed estimated sample size of 161.

[9] Providing a large part of the village with improved seeds would have increased substantially the aggregate maize production that would have eventually been traded on the local market.

[Table 1 – About here]

Bags containing 1 Kg improved seeds were randomly allocated to about half of the sample. The control group received instead, bags containing 1 Kg of the traditional seed variety.[10] The improved variety is named Situka-M1 and was released in 2001 by the Selian Agricultural Research Institute (SARI) in Tanzania. It has a high yield potential of 3-5 ton/ha and its optimal production altitude ranges 1000-1500 masl. The traditional variety instead has a yield potential of 0.5-1 ton/ha under similar conditions.[11] This relatively small quantity of seeds is sufficient for one plot of land of average size. In these villages, households have on average three plots of half a hectare each. One of these plots is always allocated to maize. Farmers planted the received seeds on one of their plots and we refer to this as their *experimental* plot. These are scattered across space and are, on average, 25 minutes walking distance from the village. Very few maize plots are located in close proximity of the village. Only 1 per cent of the plots are located within 10 minutes walk from the village while more than 20 per cent of the plots are located very far away, or more than 35 minutes walk.[12] All the plots allocated to maize were used for maize previously. We can, therefore, rule out any strategic dimension to the plot choice.

Given that our interest is to explore how a positive income shock affect the social interactions between farmers, the key outcome variables are therefore the different types of social

[10] The balance check for the predetermined variables - the standard test for randomization - is reported in Table A1 in appendix A. It shows that there is no evidence of systematic differences between the treatment and the control group.

[11] This improved variety is grown in the areas of the experiment and is the second most important open pollinated variety (OPV) in the country. About 12% of farmers in the areas of the research used Situka-M1 during the 2010/11. The variety is tolerant to both drought and pests (e.g., maize streak and grey leaf spot diseases).

[12] Vegetables and livestock are normally kept in the plot closest to the homestead.

interactions among network members. We collected this information using surveys at the begin and at the end of the experiment. As self-subsistence farmers, farming is central to the lives of the sample households and a large part of social interactions relate to agriculture. We distinguish two different types of social interaction, information sharing and labor sharing arrangements. Most information sharing pertains to crops, harvest, access to inputs and markets and land issues. We, first focus on a general type of interaction, recording with how many network members in the village the participant discussed the seeds with after they received them. This measures the very first effect on social interaction that the potential positive shock may have. The second key outcome variable is the number of network members that are asked to work on the farm of participating farmers. These labor-sharing arrangements that expand the labor input in the production process, potentially increase final harvest size. This social interaction could be affected by the size of the network; a larger network allows one to ask for more help from other (perhaps more productive) individuals. Therefore, assuming a constant marginal cost of asking for help, a larger network could induce more social interactions. On the other hand, asking network members to enter into labor sharing agreements entails both visibility and sharing of the harvest.

A farmer has, therefore, to weigh up the benefits and costs of asking for help. We can envisage a direct positive effect and two costs, a direct one and an indirect one. The positive effect is the potential increase in productivity through the increase in labor input. The direct cost is the sharing of the harvest to those who helped. The indirect cost is that, through labor sharing agreements, farmers will reveal their seeds, exposing themselves to the socially imposed *redistributive tax* as a result of potentially increased yields. Farmers in the treatment group face a clear trade-off between the marginal increase in labor productivity and the increase in these direct and indirect costs. It should be stressed that the improved variety does not require fewer labor inputs than the traditional one. We address this specific issue in the section 4.

Procedures

The successful implementation of the experiment required the collaboration among the research team, the main agricultural extension officers operating in the regions and the village leaders in all the different stages of the experiment. In November 2012, the project leader met with the extension services in Morogoro and Arusha to discuss the possibility of an agricultural experiment in the regions. They were informed that the experiment would entail the distribution of maize seeds to a randomly selected group of farmers. No information was provided on the type of seeds or the network focus of the research. In December 2012, some members of the research team and the extension service officers visited the sites and met the village leaders. From the leaders, we obtained the list of the households living in each village. They were told that an agricultural experiment would take place the next rainy season. In early January 2013, a baseline survey (reported in a separate online appendix) was undertaken with the randomly selected households. Their consent to participate to an agricultural experiment that entailed the distribution of maize varieties was explicitly requested. The baseline recorded all the relevant socio economic information, agricultural characteristics of the plots with a special focus on the maize plot. Each household provided information about the size of their social network (mapping of the network links), the type and frequency of social interactions, the potential extent of sharing pressure.

Selected farmers were informed that they were among a small minority in the village to take part in an agricultural experiment that entailed the distribution of maize seeds. They were not informed who were the other farmers taking part in the experiment and the identity of the farmers who received the seeds was not revealed to the rest of the village. Farmers that were not part of the experiment were not informed about the research activities. During the second half of January, the seeds were then discreetly distributed to the farmers in closed packages by the enumerators. Enumerators informed at the delivery what seed (improved or traditional) was provided to the farmers. The accuracy of this information was easily verifiable, as the type of seed is recognizable by eye.[13] In February 2013, at the beginning of the rainy season, farmers started planting the seeds on their experimental plots. Between February 2013 and July 2013, a number of interactions by mobile phone and in person between the enumerators and the farmers took place. Meeting in person were always held at the experimental plot and not at the homestead. A total of seven plot visits were arranged. During these visits the research team ensured that only the seeds that were provided to the participants were grown in the experimental plot.[14] The growing conditions were checked and more agronomic information on soil and agricultural practices were collected.[15] Harvest from the experimental plot took place between July 2013 and August 2013. An end-line survey (reported in a separate online appendix appendix) was also conducted to gather general information related to the harvest, agricultural inputs and practices used and on the social interactions between farmers and their network during the period of the experiment. A simple incentivized risk experiment à la Binswanger was also administered. The protocols of the risk experiment are provided in a separate online appendix to this paper.

Labour sharing agreement

In this section we clariy what are the labor sharing agreement between farmers

[13] Improved seeds have a smooth and regular shape. They are also of different color as they are treated with a fungicide to minimize seed loss during storage. This fungicide confers the seeds a purple color. Traditional varieties are never treated with fungicide and have instead a natural pale color.

[14] A critical issue of this type of field experiments is the possibility of contamination with other type of seeds.

[15] The enumerators measured the experimental plot, recorded intercropping, mulching, the distance between plants, whether weeding took place, and if fertilizer was used.

3. Empirical strategy

The analysis aims to test whether farmers, having received improved seeds, modified their social interactions with their network, focusing on interactions that are more likely to make the others aware of their higher expected income. We start by considering the social interactions that increase the indirect cost of asking for help, i.e. the risk of revealing the type of seeds received in the experiment. The main social interactions catching this effect are discussing the type of seeds received in the experiment and asking for help on the farm.

We begin by testing if individuals in the treatment group reduce interaction within the network by simply telling a smaller number of their peers about the seeds they received. We start therefore by a simple regression where the dependent variable D_i is the number of network members with whom farmer i has discussed the type of seeds received[16] and the independent variable S_i is a dummy that takes value 1 if farmer i has received the improved seed, otherwise is equal 0:

$$D_i = \beta_0 + \beta_s S_i + e_i \quad (1)$$

where e_i is the farmer i's error term. We then add the network size in the village and its interaction with the treatment (receiving improved seeds).[17] We thus, estimate the following:

$$D_i = \beta_0 + \beta_s S_i + \beta_N N_i + \beta_I N_i \cdot S_i + e_i \quad (2)$$

where N_i is the network size that farmer i has in her village and $N_i \cdot S_i$ is the interaction effect between the improved seeds dummy and the network size. We are particularly interested in the

[16] Please refer to Table 1 for a description of all the variables. In Table 1 there are also precise references to the questionnaire that we used in the experiment, which is described and reported in the Online Appendix.

[17] It may be argued that the error term might be correlated with the social network variable. Stratifying an exogenous treatment on endogenous variable, however, will yield valid estimate for the heterogenous effect. Nizalova and Murtazashvili (2014) have shown both analytically and with simulations that the OLS estimate of the interaction term in this context is still consistent if the (presumably) endogenous variable and the unobserved heterogeneity are jointly independent from the exogenous treatment. This is fulfilled thanks to the randomization of the allocation of the improved seed. As further check, we report in the appendix the estimated correlation between the interaction effect and the controls. We find no evidence of systematic and meaningful correlations.

estimated coefficient β_I. We then consider the effect of the same explanatory variables on the number of network members to which farmer i has asked for help on the farm in a labor sharing agreement. We also add a large set of controls, region and village fixed effects. Controls include individual and farm characteristics such as age of the household head, household size, female-headed household (dummy), education (dummy), risk aversion of the household head, land size, oxen (dummy), labor. We control for important environmental and climatic conditions that may affect harvest. We, therefore, include dummies for pest damage and we capture differences in the climatic conditions including the *Standardized Precipitation Index* (SPI- ARC2 dataset).[18] We also control for reciprocity by including a variable that captures the number of passive interactions, i.e. if the household head has been asked to help on the farm of other network members during the last 6 months. This is potentially an important variable as subjects may already be in labor sharing agreements. They therefore ask for help with farming only because they have been asked previously.

Lowering labor inputs will have implications in terms of harvest. By asking for less help, farmers with improved seeds do not reap the full potential of the improved seeds. We therefore investigate if there are important explicit economic implications - through lower output - as a result of the interplay between changing expected harvest and network size. Specifically, we test whether the positive effect of improved seeds is sensitive to the size of the network as a result of evasive behavior (Bandiera and Rasul, 2006). In order to test for this, we estimate a model similar to equation (2) except that the dependent variable is harvest instead of the social interactions.

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[18] This index captures the rarity of a drought at a given time scale of interest for any rainfall station with historic data. It can also be used to determine periods of anomalously wet events. Being a standardized measure, it identifies normal conditions when close to zero. High SPI value corresponds to heavy precipitation event over time period specified while low SPI signal situations of low precipitation event. The lower the SPI the more dramatic is the drought. We used the GIS information to locate the farmers and then matched this information with rainfall data to produce the SPI.

4. Empirical results

Table 2 reports the results for the social interactions that may reveal seed type and thus inform other members of the network about the relatively large expected increase in harvest that the participant will experience. The first three columns present the results for the number of network members with whom the participant has discussed the seed type they received after the reception. The remaining three columns report the result for the number of network member the participant has made labor sharing agreements with after the reception of the seeds. We provide results for different specifications. We first report a baseline specifications without controls, we then add the size of the network and its interaction with the positive shock, and finally add a battery of controls and village fixed effects. The baseline results reported in columns (1) and (4) show that compared to the control group, individuals assigned the improved seeds reduced their network interactions that would make other aware of their expected large increase in harvest (by either directly discussing their seeds or working in their farm) from the moment they received the seeds. The estimated coefficient for the treatment variable (positive harvest shock) is indeed negative and statistically significant (at 10%) in both baseline regressions.

[Table 2- About - here]

How does the participant size of the network in the village affect these results? Column (2) and (4) in Table 2 presents the results of the extended model including the effect of network size. We find that the effect of improved seeds on the number of members with whom the seed type was revealed is sensitive to the size of the network. The effect of the size of the network is positive and significant. This captures the fact that the larger the network the larger the number of people with whom one can discuss the seeds or can ask to work in her farm. The interaction between the size of the network and the positive harvest shock is negative and statistically significant. This implies that for the farmers in the treatment group, the larger the kin network the smaller the number of members of the network they have discussions about the type of seeds.. This difference increases with network size. Same pattern applies to labor sharing agreements. These are important social interactions that would make the seeds and potential harvest more visible, thus exposing participants receiving a relatively large expected income shock to more redistributive pressure. Let us consider a situation in which a farmer normally asks some members of her network to come on her operating plots and help with agricultural activities (e.g., land preparation, seeding, harvesting). If she has the improved seeds and she does not want to share harvest with all of them (i.e., she does not want to be taxed), she may ask only a smaller number of more trusted members. Perhaps, those individuals are less likely to diffuse the information about their expected harvest with the rest of the network. In general, we can envisage that while larger networks provide more opportunities to get valuable information and increase labor availability they may also trigger higher redistributive pressure. Our results highlights that in the presence of a relatively large harvest shock (improved vs. traditional seed) the 'cost of the social ties' captured by the redistribution dominates the 'benefits of social ties.'[19]

Results are also quantitatively non trivial. Column (4), for instance, shows that on average, farmers with improved seeds asked 0.35 less people for help on the farm (significant at the 10% confidence level). Column (5) shows that the larger the network size, the less farmers with improved seeds asked for less help on their plots. Estimated at the village network size sample mean value (10.5) farmers in the treatment group invited on average 0.2 fewer people to work with them. This number becomes much larger once we consider larger network. To illustrate,

[19] Alternative explanations are also possible. For instance, it may be somehow related to the fact that output is produced by a new technology (improved seeds). We thank the anonymous reviewer for pointing this out.

farmers with a village network of 20 people for would ask on average 0.5 fewer people to work in their farm, while farmers with a village network of 30 would invite 0.8 fewer people. To put things in perspective, it should be stressed that in a self-subsistence farming system, characterized by low technology adoption and zero mechanization even small reduction in the labor inputs may have important implications.

To probe the robustness of our results we add a large battery of controls, region and village fixed effects. Results are reported on columns (3) and (6) of Table 2 and are consistent across specifications. Moreover, in order to take into account the count data nature of the dependent variables and the large number of zeroes, we implemented a Poisson model.[20] Results are shown in table A3 in the appendix and are found to be very comparable to the ones obtained with simple OLS.

We now investigate the economic implications of such different behavior. We test for this by comparing harvest between farmers with improved and traditional seeds at various network sizes. Results are robust to different specifications and are presented in table 3.

[Table 3 – About here]

On average, improved seeds increase expected harvest by 60%,[21] as shown in column (1). Furthermore, the size of network for farmers with traditional seeds increases the harvest by 4% for each additional member. This is coherent with the idea that the network provides some important services (e.g., information and labor resources). A different pattern emerges, however, for the treatment group. For farmers with a large network (20 members or more, i.e.

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[20] It should be noted that the Poisson regression helps dealing with the skewness of the dependent variables of interest.

[21] The increase in the harvest found in our field experiment is much smaller than the one found in the agronomic trials implemented in the agricultural research stations. This is because that in the latter the growing conditions for the crop are optimal (e.g., optimal soil moisture and nitrogen).

15% of the sample), the evasive behavior severely reduces the benefit of the improved seeds up to completely canceling out. These results are summarized in Figure 1.

[Figure 1– About here]

All regression results are presented with standard error robust to clustering at the village level and corrected for small cluster size (Cameron, Gelbach and Miller, 2008). Alternative specifications with standard clustering procedures and robust standard errors provide very consistent results and are also presented in table A3. We have also considered specifications were more interaction terms between some controls that have affect the network size (e.g., household size, reciprocity, leadership, education and assets) and the treatment dummy are also included. Results are very consistent and available upon request.

5. Robustness checks and alternative explanations

We further probe our results for alternative explanations by undertaking a set of checks. We are particularly interested in probing the mechanism of evasive behavior in response to the increase in the expected harvest. We therefore estimate if a similar pattern would be found in other types social interactions that do not directly involve discussing the new seeds or viewing the plot. We first tested our hypotheses on four social interactions implying no direct visibility, as the interaction does not take place on the farm of the participants on the experiment. These include general discussions on output markets, on land markets, and on best farming practices. Results are reported in Table 4

[Table 4 – About here]

We do not find any sign of evasive behavior. Farmers with improved seeds do not differ from farmers with traditional seeds in the number of social interactions with no direct visibility. Furthermore, the effect of network size does not differ between control and treatment groups as shown by the lack of significance of the interaction term. Results suggest that evasive behavior does not take place in social interactions that do not increase the risk of incurring a redistributive family tax. Moreover, we test if the evasive behavior is found when we consider the social interaction with network members living outside the village (see table 5 for the results). We find similar qualitative results when we consider whether they discussed the type of seeds they received.

[Table 5 – About here]

We find no statistical evidence of a similar effect on labor sharing agreements. This result highlights the importance of the visibility implied by the interaction with individuals living in the same village. An important potential issue is probing if individuals that are randomly assigned the positive expected income shock would enter in less labor sharing agreements for reasons other than sharing pressure. One could argue, for instance, that if the technology requires less labor than our interpretation could be muddied. Evidence from agronomic research suggests that in fact, the opposite effect may take place. Typically, improved varieties require more complementary inputs and more time invested in better agricultural practices, as well as optimal soil nutrients and moisture conditions to obtain very high yields (e.g., Byerlee and Polanco, 1986; Smale et al., 1995; Doss, 2006). In order to fully exploit the productive advantage of the improved variety therefore *more* labor to undertake agricultural practices should be employed (e.g., in soil preparation, ploughing and weeding). We tested if treatment and control groups are statistically different in these agricultural practices to rule out the hypothesis that improved seeds require less practices. We find no evidence of such pattern. We report the results in the Table 6.

[Table 6 - about here]

A critical issue is if the size of the network is an appropriate metrics or proxy for redistributive pressure. A good proxy to capture the extent of sharing pressure experienced by the farmer at the village level is the answer to the question: “How many people in this village are you expected to help if they asked you for help?". This is a measure of potential (and not actual) social interactions with other farmers living in the same village.[22]

We name this variable expected sharing pressure. Table 7 reports the results for the estimated models by using expected sharing pressure in place of village network size.[23] Results are largely consistent. In fact only the regression where the dependent variable is the number of network members with whom the type of seeds were discussed, displays much larger standard errors when the expected sharing pressure. Results are qualitatively very similar.

[Table 7 - about here]

We also provide in the appendix the results of robustness checks reported in Table 4 using the expected sharing pressure variable in Table A4. Results are very consistent with the pattern identified in Table 4.

It should be noted that while village network size varies between 0 and 72 with an average of 10.5. To probe the robustness of the results we re-run the analysis by using alternative transformations of our network measure. First, we discretize the network variable and recode it according to the percentile category (25, 50, 75, 99). Second, we take the log of network size (plus one to deal with the zeros). Results are very consistent to the previous ones and are reported in Table 8.

[Table 8 - about here]

[22] This question does not specify the degree of relationship, it only records if individuals are expected to help others in the village in case they would be in need.

[23] For consistency we report in the table A2 in the appendix the estimated correlation between the interaction effect between positive shock and expected sharing pressure and the controls. Again, we find no evidence of systematic and meaningful correlations.

At this stage of the paper it is important to note that there are still two alternative explanations that we cannot rule out for lack appropriate data.[24] First, as discussed in the end of previous section, the new improved seed requires more labor at a new bliss point, but may still deliver higher yield with the same amount of labor that is optimal with the traditional seed. So, farmers may choose to obtain to the old level of production, that is sub-optimal with the improved seed, and fear that the extended family members could react to this choice. So, it may not be the fear of a redistributive family tax that prevents them to ask for help in harvesting, but rather the fear of family pressure to work harder.

The second possible explanation that cannot be ruled out is that farmers may not fully exploit the new opportunity because they fear envy from other people (also called "evil eye"), and a large number of extended family members implies higher repercussions moved by envy: these could be concrete effects as destruction of property or malicious gossip, or even witchcraft punishments (as documented by Gershman, 2015, 2016).

Both previous explanations are based on the assumption of non-standard utility functions. Farmers aim to maximize a utility function that considers not only the trade-off between labor and profit but also some kind of social outcome spreading from their network and depending on their decisions. In the first explanation, their utility function is affected by the predicted behavior of their extended family in response to their decisions. In the second explanation, the feelings of envy that could arise in their network affect their utility function. We note though that these two possible explanations are based on the assumption that the revelation of the income shock generates some kind of (social) cost. So, subjects to reduce the impact of these social costs reduce those social interactions that imply visibility of the income shock.

[24] We thank an anonymous referee for pointing this out. In a recent work, Squires (2016) also shows, with a lab experiment, that people from a Kenyan rural area have a strong preference for hiding their income to peers.

5. Concluding remarks

In this paper we present empirical evidence of the economic implications of social networks in the developing world. We frame the issue with a model where network clustering has an effect on an individual's decisions. The model predicts that individuals wanting to reduce redistributive pressure from other network members may reduce their social interactions. This includes a reduction in social interactions that could have provided gain through increased output. We implemented a field experiment that relied on the random assignment of improved seeds that greatly increase the expected maize harvest. We find that farmers receiving improved seeds interact less with their social network. The treated group is not only are less likely to discuss with other farmers their seeds, but also entered into fewer labor sharing agreements than in the control group. This indicates that evasive responses may be made to avoid network-sharing pressures. Farmers that receive positive income shocks prefer to reduce their visibility by reducing involvement with their network rather than facing the risk of higher redistributive pressure and, as a result, obtained fewer harvest gains. These findings echo the work of Baland et al. (2011) where farmers in Cameroon were ready to incur a cost to avoid being taxed by their network. In the case presented in this article, the cost is the forgone marginal productivity of labor on a plot with improved seeds. Hence, both studies highlight another mechanism by which the *dark side* of social capital can compromise wellbeing: the inefficiency is not only due to *disincentivized* farmers free-riding on the solidarity of their peers, but to a suboptimal level of labor due to the fear of being subject to redistributive pressure. Although it is difficult to draw any conclusion on the long-term welfare equilibrium dynamics due to the cross-sectional nature of the present study, this implicit cost can be interpreted as the *deadweight loss* of the informal insurance system embedded in social networks. It is a *deadweight loss* because the additional food that could have been produced by marginally increasing labor will not exist.

The members of the solidarity network will have fewer resources to share.

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Tables

Table 1. Variables definitions and summary statistics

Variable	Definition	Mean	Standard Dev	Min	Max
Number of network members with whom the type of seeds were discussed (D_i in the regressions)	Number of village network members with whom the received seeds were discussed	2.85	2.35	0.00	10.00
Number of network members in labor sharing agreements	Number of village network members the farmer asked for help on the farm.	1.9	2.76	0.00	20
Harvest	Harvest from the experimental plot in kg	82.20	72.48	0.00	280.00
Number of interactions with network members on markets	Number of village network members with whom the farmer has discusses markets during the experiment	0.84	1.31	0.00	5.00
Number of interactions on agricultural practices	Number of village network members with whom the farmer has discussed farming practices during the experiment	0.89	1.12	0.00	5.00
Number of interactions with network members on land issues	Number of village network members with whom the farmer has discussed land issues during the experiment	0.88	1.34	0.00	5.00
Positive harvest shock	Treatment dummy (1= improved variety; 0=traditional)	0.47	0.50	0.00	1.00
Network size inside the village (N_i in the regressions)	Number of network members (number of relatives and kin) inside the village	10.5	10.97	0.00	72
Network size outside the village	Number of network members (number of relatives and kin) outside the village	7.16	9.99	0.00	73
Expected sharing pressure	Number of individuals in the village you are expected to help in case they would be in need and asked you	2.13	3.79	0	30
Age of household head	Age of household head (years)	44.07	10.08	16.00	70.00
Household size	Number of family members living under the same roof	4.95	2.00	1.00	10.00
Leadership role in the community	Does a member of the household has a leadership role in the	0.17	0.37	0.00	1.00

	community (1= Yes; 0=otherwise)				
Female headed household	Gender of household head (1= Female; 0=otherwise))	0.11	0.32	0.00	1.00
Secondary education	Does the household head completed secondary education after the primary? (1= Yes; 0=otherwise))	0.60	0.49	0.00	1.0
Risk averse	If plot 1 in the risk experiment is chosen (1= Yes; 0=otherwise))	22%	0.41	0.00	1.00
Farm size	Size of the operated plots from the household (ha)	1.41	0.92	0.00	4.05
Oxen	Do you own an oxen? (1= Yes; 0=otherwise)	23%			
Labor	How many days in total were members in your household worked on the experimental plot? (man day)	8.25	4.83	0.00	22.00
Pest damage	Did you experience pest damage on the experimental plot during the length of the experiment? (1= Yes; 0=otherwise)	23%	0.42	0.00	1.00
Reciprocity	Has the household head s been asked to help on the farm of other network members during the last 6 months.	1.7	2.95	0	20
Standardized Precipitation Index (SPI – ARC2)	Measure of rainfall anomaly that could have been experienced in the village neighborhood. It is the amount of rainfall during the maize growing season minus the rainfall long term average divided by its standard deviation.	0.22	0.66	-1.27	0.91
Location South -East (1= Yes; 0=otherwise))	Location South -East (1= Yes; 0=otherwise))	41%			

Table 2: Social interactions with the network in the village revealing the seed type

Dep Vars	**Number of network members with whom you discussed the seeds received**			**Number of network members labor sharing agreements made with**		
	Baseline	No controls	Controls and village FE	Baseline	No controls	Controls and village FE

	(1)	(2)	(3)	(4)	(5)	(6)
Positive harvest shock	-0.66*	0.74	0.529	-0.35*	0.14	0.153
	(0.37)	(0.83)	(0.685)	(0.21)	(0.26)	(0.239)
Network size		0.15**	0.133***		0.06***	0.0491**
		(0.06)	(0.0472)		(0.02)	(0.0224)
Positive harvest shock*Network size		-0.13*	-0.125**		-0.04***	-0.0329*
		(0.07)	(0.0543)		(0.02)	(0.0180)
N	314	313	313	311	311	311

Village clustered and corrected for small cluster size standard errors in parenthesis.
Significance code: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.
Controls: age of the household head, household size, female headed household (dummy), education (dummy), risk aversion of the household head, land size, oxen (dummy), labor, reciprocity, HH member is the village leader, pest damage (dummy), Standardized Precipitation Index (SPI - ARC2 dataset), dummy for region. Constants not reported.

Table 3: Dependent Variable: Harvest (in logs)

	Baseline	No controls	Controls	Controls and village FE
	(1)	(2)	(3)	(4)
Positive harvest shock	0.58***	0.97***	0.84***	0.920***
	(0.16)	(0.25)	(0.26)	(0.224)
Network size		0.04***	0.04***	0.0341***
		(0.01)	(0.01)	(0.0129)
Positive harvest shock*Network size		-0.03***	-0.03**	-0.0362***
		(0.01)	(0.01)	(0.00963)
N	309	308	308	308

Village clustered and corrected for small cluster size standard errors in parenthesis.
Significance code: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.
Controls: age of the household head, household size, female headed household (dummy), education (dummy), risk aversion of the household head, land size, oxen (dummy), labor, reciprocity, HH member is the village leader, pest damage (dummy), Standardized Precipitation Index (SPI - ARC2 dataset), dummy for region. Constants not reported. Column (5) reports the results with network size (plus one to deal with the zeros) in logs.

Table 4: Social interactions with the network in the village not revealing the seed type

Dep. Var:	**Number of network members with whom you discussed market issues**			**Number of network members with whom you discussed agricultural practices**			**Number of network members with whom you discussed land issues**		
	Baseline	No Controls	Controls Village FE	Baseline	No Controls	Controls Village FE	Baseline	No Controls	Controls Village FE

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Positive harvest shock	0.53	-0.03	-0.06	0.08	-0.29	-0.31	0.13	-0.44	-0.44
	(0.44)	(0.72)	(0.71)	(0.28)	(0.49)	(0.42)	(0.30)	(0.44)	(0.37)
Network size		0.05^{***}	0.06^{***}		0.06^{***}	0.06^{***}		0.06^{***}	0.07^{***}
		(0.01)	(0.01)		(0.01)	(0.01)		(0.01)	(0.01)
Positive harvest shock*Network size		0.06	0.05		0.04	0.04		0.06	0.06
		(0.07)	(0.06)		(0.06)	(0.06)		(0.06)	(0.05)
N	313	313	313	313	313	313	313	313	313

Village clustered and corrected for small cluster size standard errors in parenthesis. Significance code: * p < 0.10, ** p < 0.05, *** p < 0.01.
Controls: age of the household head, household size, female headed household (dummy), education (dummy), risk aversion of the household head, land size, oxen (dummy), labor, reciprocity, HH member is the village leader, pest damage (dummy), Standardized Precipitation Index (SPI - ARC2 dataset), dummy for region. Constants not reported.

Table 5. Social interactions that reveal seed type with the network outside the village

Dep Var:	**Discussing seed type**		**Labor sharing agreements**	
	Baseline	Controls and Village FE	Baseline	Controls and Village FE
	(1)	(2)	(3)	(4)
Positive harvest shock	0.301	0.169	-0.179	-0.157
	(0.539)	(0.500)	(0.376)	(0.362)
Network size	0.156^{***}	0.133^{***}	0.0240	0.0238
	(0.0406)	(0.0453)	(0.0198)	(0.0151)
Positive harvest shock*Network size	-0.120^{***}	-0.144^{***}	-0.0230	-0.0285
	(0.0363)	(0.0421)	(0.0297)	(0.0311)
N	312	312	310	310

Village clustered and corrected for small cluster size standard errors in parenthesis. Significance code: * p < 0.10, ** p < 0.05, *** p < 0.01.
Controls: age of the household head, household size, female headed household (dummy), education (dummy), risk aversion of the household head, land size, oxen (dummy), labor, reciprocity, HH member is the village leader, pest damage (dummy), Standardized Precipitation Index (SPI - ARC2 dataset), dummy for region. Constants not reported.

Table 6. Do the improved seeds require less complementary inputs?

	Treatment	Control	Difference (Treatment – Control)	p-value
Soil preparation	2.16	2.14	0.02	0.88
Weeding	1.49	1.45	0.04	0.65
Intercropping	1.78	1.54	0.24	0.31
Fertilizer / pesticides	0.28	0.28	0.00	0.91

T-test on the means, null hypothesis H_0: Difference=0

Table 7. Social interaction, harvest and expected sharing pressure

	Number of network members with whom you discussed the seeds received		**Number of network members labor sharing agreements made with**		**Harvest (in logs)**	
	No controls	Controls	No controls	Controls	No controls	Controls
	(1)	(2)	(3)	(4)	(5)	(6)
Positive harvest shock	-0.689	-0.697	-0.128	0.102	0.710^{***}	0.721^{***}
	(0.444)	(0.458)	(0.227)	(0.0809)	(0.166)	(0.181)
Expected sharing pressure	0.0534	0.0392	0.0940	0.0802^{**}	0.0482^{***}	0.0480^{**}
	(0.0786)	(0.0831)	(0.0710)	(0.0314)	(0.0185)	(0.0196)
Positive harvest shock*Expected sharing pressure	-0.0293	-0.0182	-0.0925^{**}	-0.104^{*}	-0.0444^{**}	-0.0587^{**}
	(0.110)	(0.104)	(0.0393)	(0.0542)	(0.0198)	(0.0280)
N	300	299	300	298	295	294

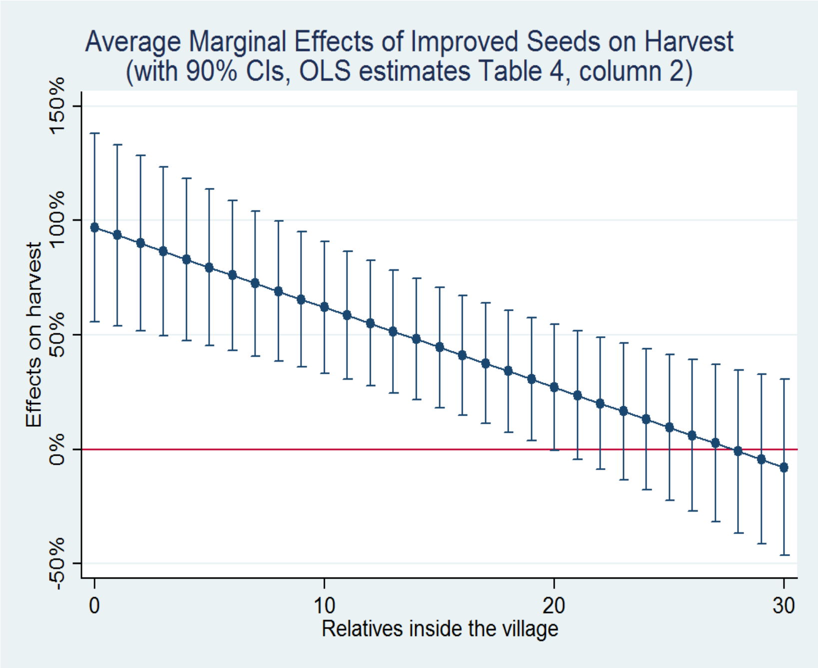
Village clustered and corrected for small cluster size standard errors in parenthesis. Significance code: * p < 0.10, ** p < 0.05, *** p < 0.01. Controls: age of the household head, household size, female headed household (dummy), education (dummy), risk aversion of the household head, land size, oxen (dummy), labor, reciprocity, HH member is the village leader, pest damage (dummy), Standardized Precipitation Index (SPI - ARC2 dataset), village network size, dummy for region. All specifications with village fixed effects. Constants not reported.

Table 8. Alternative measure for network pressure

Dep Vars.	**Number of network members with whom you discussed the seeds received**		**Number of network members with whom you made labor sharing agreements with**		**Harvest (in logs)**	
Alternative Network measure	Percentiles	Log (network size+1)	Percentiles	Log (network size+1)	Percentiles	Log (network size+1)
	(1)	(2)	(3)	(4)	(5)	(6)
Positive harvest shock	0.472	0.779	0.428**	0.603***	1.109***	1.475***
	(0.719)	(1.037)	(0.178)	(0.200)	(0.280)	(0.339)
Network	1.002***	1.029**	0.410**	0.370**	0.363***	0.452***
	(0.333)	(0.420)	(0.190)	(0.160)	(0.0926)	(0.113)
Positive harvest shock* Network	-0.809*	-0.755	-0.426**	-0.417***	-0.377***	-0.464***
	(0.460)	(0.486)	(0.188)	(0.154)	(0.0955)	(0.102)
N	314	313	311	311	309	308

Village clustered and corrected for small cluster size standard errors in parenthesis. Significance code: * p < 0.10, ** p < 0.05, *** p < 0.01. Controls: age of the household head, household size, female headed household (dummy), education (dummy), risk aversion of the household head, land size, oxen (dummy), labor, reciprocity, HH member is the village leader, pest damage (dummy), Standardized Precipitation Index (SPI - ARC2 dataset), dummy for region. All specifications include village fixed effects. Constants not reported.

Figure 1: Harvest vs Size of network



Appendix

In this appendix we provide four tables. Tables A1 and A2 are checks on the treatment randomization. Tables A3 and A4 are robustness check cited in Section 4 of the paper.

Table A1. Balance check

	Treatment	Control	Difference (Treatment – Control)
Network size in the village	9.99	10.96	-0.97
Network size outside the village	6.6	7.67	-1.06
Expected sharing pressure	1.97	2.28	-0.3
Risk averse	0.20	0.21	0.00
Household size	5.2	5.04	0.17
Land size (ha)	1.54	1.61	-0.07
Oxen	0.23	0.22	0.00
Labor	10.04	8.57	1.46*
Female	0.09	0.14	-0.037
Education	0.60	0.59	0.01

Leadership role in the community	0.189	0.144	0.044
Pest damage	0.179	0.26	-0.07
Standardized precipitation Index	0.27	0.17	0.09
Age of the household head	45.49	44.95	-0.45
Been asked for help in other farms (reciprocity)	1.77	1.72	0.05
Standardized Precipitation Index	0.27	0.17	0.09

T-test on the means, null hypothesis H_0: Difference=0

Table A2. Correlation between the interactions and the controls

Dep. Vars.	**Positive harvest shock *Network size**	**Positive harvest shock* Expected sharing pressure**
	(1)	(2)
Age of the household head	-0.00816	-0.0111
	(0.0712)	(0.0176)
HH size	-0.333	-0.147*
	(0.233)	(0.0821)
Leadership role in the community	1.891	0.241
	(1.768)	(0.476)
Female household head	-1.397	-0.160
	(1.402)	(0.661)
Education	1.547**	0.619
	(0.731)	(0.437)
Risk Averse	0.680	-0.628**
	(1.632)	(0.269)
Land	0.165	-0.0800
	(0.374)	(0.0925)
Oxen	-0.0955	0.135
	(0.488)	(0.229)
Labor	0.115	0.0220
	(0.0870)	(0.0293)
Pest damage	0.734	-0.0742
	(1.709)	(0.339)
Standardized Precipitation Index	2.774	0.518
	(2.991)	(0.443)

Reciprocity	0.281	-0.0273
	(0.399)	(0.0359)
N	313	299

Village clustered and corrected for small cluster size standard errors in parenthesis.
Significance code: * p < 0.10, ** p < 0.05, *** p < 0.01. All specifications include village and region fixed effects. Constants not reported.

Table A3: Social interactions and harvest. Alternative estimators and standard errors

	Discussing seed type	Discussing seed type	Labor sharing agreements	Labor sharing agreements	Harvest
	Poisson (1)	Robust (2)	Poisson (3)	Robust (4)	Robust (5)
Positive harvest shock	0.07	0.529	0.15	0.06	0.920***
	(0.09)	(0.758)	(0.286)	(0.12)	(0.264)
Network size	0.03***	0.133**	0.0491***	0.03***	0.0341***
	(0.00)	(0.0523)	(0.018)	(0.01)	(0.0131)
Positive harvest shock*Network size	-0.03***	-0.125**	-0.0329	-0.02***	-0.0362**
	(0.00)	(0.0609)	(0.0220)	(0.01)	(0.0161)
Observations	313	313	311	311	308

Columns (1) and (3) Village clustered standard errors in parenthesis. Columns (2), (4), and (5) robust standard errors are used. Significance code: * p < 0.10, ** p < 0.05, *** p < 0.01.
All specifications include as controls: age of the household head, household size, female headed household (dummy), education (dummy), risk aversion of the household head, land size, oxen (dummy), labor, reciprocity, HH member is the village leader, pest damage (dummy), Standardized Precipitation Index (SPI - ARC2 dataset), dummy for region. All reported results with village fixed effects. Constants not reported.

Table A4. Social interactions with the network in the village not revealing seed information and expected sharing pressure

	Number of interactions with network members on markets		**Number of interactions with network members on agricultural practices**		**Number of interactions with network members on land issues**	
	No controls	Controls included	No controls	Controls included	No controls	Controls included
	(10)	(11)	(12)	(13)	(14)	(15)
Positive harvest shock	0.318	0.375	-0.0626	0.00631	0.0204	0.191
	(0.538)	(0.523)	(0.150)	(0.157)	(0.169)	(0.156)
Expected sharing pressure	-0.0340	-0.0396	0.0222	0.0241	0.0348	0.0313

	(0.0308)	(0.0347)	(0.0323)	(0.0306)	(0.0218)	(0.0239)
Positive harvest shock*Expected sharing pressure	-0.0287	-0.0712	-0.0324	-0.0678*	-0.0320	-0.0706**
	(0.0758)	(0.0787)	(0.0423)	(0.0382)	(0.0394)	(0.0341)
N	299	299	299	299	299	298

Village clustered and corrected for small cluster size standard errors in parenthesis.
Significance code: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.
Controls: age of the household head, household size, female-headed household (dummy), education (dummy), risk aversion of the household head, land size, oxen (dummy), labor, reciprocity, HH member is the village leader, pest damage (dummy), village network size, Standardized Precipitation Index (SPI - ARC2 dataset). All specifications include village and region fixed effects. Constants not reported.

Online appendix

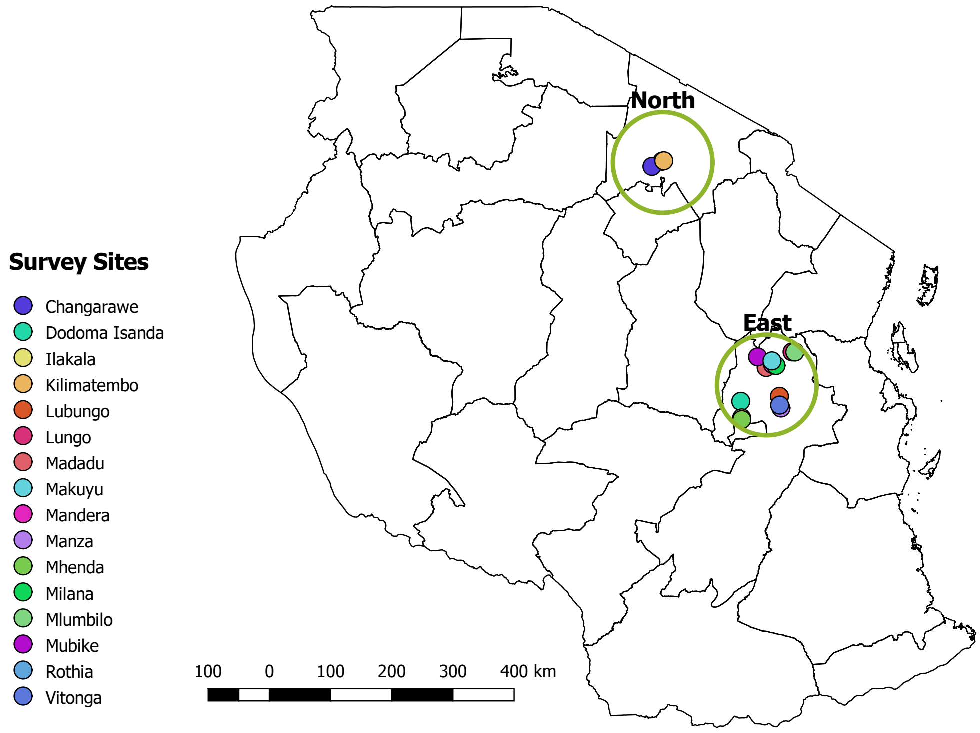
Protocol

1 Experimental protocol

We describe below the experimental protocol in more details. We provide a description of the area where the survey sites are located, the seeds that were used in the experiments, the survey team and the data collection process. The protocol for the risk experiment is attached as well as the consent form and the survey instrument for collecting the information on social network and social interactions.

1.1 Survey sites

The data are based on a RCTs ran in the 2013 main growing season: January to August. The farmers were spread in three districts of Tanzania (Karatu, Mvomero and Kilosa, see map 1), representing the main agri-ecological zones of Tanzania. Karatu, in the northern part of Tanzania, is located next to the natural Ngorongoro conservation area and to the tarmac road which brings numerous visitors each year to the Serengeti national park. Despite the proximity of this tourist attraction, farmers in the surrounding villages do not benefit much from this flow of travellers as most do not stop in Karatu. The 399 farmers who took part to the experiment in Karatu district live in three villages that are within a maximum of 20 km of each other. Despite their relative proximity, each one belongs to a distinct agro-ecological zone: Changarawe is located at an altitude of 1350m-1450m with a dry climate; Kilimatembo and Rothia benefit from wetter conditions and are located at an altitude of 1500m-1600m and 1600m-1700m respectively. The 290 farmers who took part to the study in the East are spread over two districts (Kilosa and Mvomero) and 13 villages. By contrast to the Karatu area, there are no tourist activities and these villages are far more remote from one another - the maximum distance between each one being close to 140 km. They are located at a lower altitude, between 500m and 1075m and are diverse in terms of humidity. Most are distant from any tarmac road and the closest village to the regional centre, Morogoro, is still 25 km away from it.



1.2 Maize Seeds

The improved seeds tested in the current study, the Situka-M1, was released in 2001 by Selian Agricultural Research Institute (SARI). It has a yield potential of 3-5 ton/ha and its optimal production altitude ranges from 1000 to 1500m above sea level. In Tanzania, it can grow in the Eastern and Northern regions where our study areas are located. The variety is tolerant to drought, maize streak and grey leaf spot diseases, and resistant to *Diplodia* fungus, *Fusarium* leaf bright and *Puccinia sorghi*. Although its yields are often advertised as 4 to 6 ton/ha by the government (Ministry of Agriculture, Food Security and Cooperatives. 2009, cit. in Tumbo et al. 2012) or grain dealers (e.g. Suba Agro-Trading & Engineering Co. Ltd[30]), CIMMYT found considerably lower yields, from 2.4 ton /ha in a mid-altitude dry environment to 4 ton/ha in a mid-altitude humid hot environment (Magorokosho et al. 2009).

Kassie et al. found (2014) that one fifth of the farmers adopted improved maize seeds in the study area (20% in Karatu, 25% in Kilosa and 17% Mvomero) while Amare et al. (2012) report an adoption rate of 50% in Karatu. Maize accounts on average for 70% of crop production and constitute 80% of domestic food production consumption in the study area (Kassie et al. 2014). Kassie et al. (2014) found yields of 1.2 t per ha for adopters of improved maize varieties compared to 0.5 t. per ha for local varieties.

1.3 Data collection

The successful implementation of the experiment required the collaboration among the research team, the main agricultural extension officers operating in the regions and the village leaders in all the different stages of the experiment. The team in the Eastern area was comprised of 15 trained enumerators employed on a regular basis by CYMMIT to collect data. They were supervised by one extension agent. The team structure was similar for the Northern area (15 trained enumerators, one extension agent to supervise) and support was provided by the Selian Agricultural Research Institute (SARI).

Here is timeline of the study:

- In November 2012, the project leader met with the extension services in Morogoro and Arusha to discuss the possibility of an agricultural experiment in the regions. They were informed that the experiment would entail the distribution of maize seeds to a randomly selected group of farmers. No information was provided on the type of seeds or the network focus of the research.
- In December 2012, two members of the research team and the extension service officers visited the sites and met the village leaders. From the leaders, we obtained the list of the households living in each village. They were told that an agricultural experiment would take place the next rainy season. Co-authors piloted with 5 households in the North and East area the baseline questionnaire.
- In early January 2013, the baseline survey was undertaken with the randomly selected households. Their consent to participate to an agricultural experiment that entailed the distribution of maize varieties was explicitly requested by the enumerator (consent form below).

- The baseline recorded all the relevant socio economic information, agricultural characteristics of the plots with a special focus on the maize plot. Each household provided information about the size of their social network (mapping of the network links), the type and frequency of social interactions, the potential extent of sharing pressure. The survey instruments related to social network is provided below. Selected farmers were informed that they were among a small minority in the village to take part in an agricultural experiment that entailed the distribution of maize seeds. They were not informed who were the other farmers taking part in the experiment and the identity of the farmers who received the seeds was not revealed to the rest of the village. Farmers that were not part of the experiment were not informed about the research activities.
- During the second half of January, improved maize seeds (Situka-M1) were bought at the Tanganyika Farmer Association, a seed dealer, and traditional seeds were bought to a local grain seller in both North and East regions. They were then discreetly distributed to the farmers in closed packages by the enumerators. Enumerators informed at the delivery what seed (improved or traditional) was provided to the farmers. The accuracy of this information was easily verifiable, as the type of seed is recognizable by eye.[25]
- In February 2013, at the beginning of the rainy season, farmers started planting the seeds on their experimental plots.
- Co-authors came 5 time for up to two weeks stays until June in order to ensure that only the seeds that were provided to the participants were grown in the experimental plot,[26] to check growing conditions[27], collect mid-line data and pilot the end-line survey. Meeting with participants were always held at the experimental plot and not at the homestead. In early June, a mid-line survey was administered: farmers where asked if they had planted the seeds, more agronomic information on soil and agricultural practices were collected and plot sizes were measured by the enumerators. The extensions agents trained groups of 5 enumerators at a time on measuring fields with tape measures. During the training, GPS devices were used by co-authors to check the accuracy of land measurement. Close to 50 fields were hence visited by the co-authors.

[25] Improved seeds have a smooth and regular shape. They are also of different color as they are treated with a fungicide to minimize seed loss during storage. This fungicide confers the seeds a purple color. Traditional varieties are never treated with fungicide and have instead a natural pale color.

[26] A critical issue of this type of field experiments is the possibility of contamination with other type of seeds.

[27] The enumerators measured the experimental plot, recorded intercropping, mulching, the distance between plants, whether weeding took place, and if fertilizer was used.

Lastly, co-authors piloted the end-line survey with 5 household in the Northern and in the Eastern area.

- Harvest from the experimental plot took place between July 2013 and August 2013. The end-line survey was conducted to gather general information related to the harvest, agricultural inputs and practices used and on the social interactions between farmers and their network during the period of the experiment. A simple incentivized risk experiment à la Binswanger was also administered. The protocols of the risk experiment is provided below.

2 Consent forms

Survey Randomized Controlled Trial Maize January 2013
Introductory Statement (to be read to the respondent): "We are coming from the University of Geneva (Switzerland) in collaboration with CIMMYT to talk to you about agricultural production and offer you to take part to a study. You will receive seeds from our part in in the next two weeks. We will come back at harvest to measure the harvest and gather information on your farming practices. Naturally, all the harvest is yours, we won't take any. We are now going to ask questions about your crop and livestock activities. We will also ask questions about your household's access to information, and credit, your participation in community groups, and recent climate experiences or shocks. If you agree to participate, the information you provide will be used for research purposes only. Your answers will not affect any benefits or subsidies you may receive now or in the future. Your responses to these questions will be anonymous and remain strictly confidential. Your name will not appear in any data that is made publicly available. Do you consent to take part to this study and to provide information for this study? You may withdraw from the study at any time and if there are questions that you would prefer not to answer then we respect your right not to answer them. Has consent been given? *(01=Yes, 00=No)* [_ _]

3 Sections of the questionnaire that we use

K. Social network

		Number of people you had commitments/actual interactions in this village since you received the seeds				e. Did you have interactions with people outside your village? 1=Yes 2=No	POSSIBLE INTERACTIONS	
List	Code	a. Did you ask or consult from someone else? 1=Yes 2=No	b. Number people you asked or consulted	c. Did someone else ask or consult you? 1=Yes 2=No	d. Number of people you were asked or consulted by		f. How many people in this village **do you expect** to receive help from **if you would be in need** and if you asked them? (if none, write 0)	g. How many people in this village **do you expect** to help**, if they would be in need** and if they asked you for help? if none, write 0)
Cash credit (more than 2000 Tsh)	K2							
Credit in-kind (more than 2000 Tsh in value)	K3							
Help in any farming activity	K4							
Information about crop output markets	K5							
Information about land rental market (availability of tenants/landlords)	K6							

Information regarding farming practices, new technologies, use of modern inputs such as fertilizer, etc.	K7							
Information about maize production and varieties selection	K8							

List	Code	h. How many **relatives** living **in this village** you would **ask for help**? (if none, write 0)	i. How many **relatives** living **in this village** would you **offer help to**? (if none, write 0)	j. How many **relatives** living **outside this village** you would **ask for help**? (if none, write 0)	k. How many **relatives** living **outside this village** would you **offer help to**? (if none, write 0)
Cash credit (more than 2000 Tsh)	K2				
Credit in-kind (more than 2000 Tsh in value)	K3				
Help in any farming activity	K4				
Information about crop output markets	K5				
Information about land rental market (availability of tenants/landlords)	K6				
Information regarding farming practices, new	K7				

technologies, use of modern inputs such as fertilizer, etc.					
Information about maize production and varieties selection	K8				

K.9 With how many people did you discuss the experiment since you got the seeds? ______________________________

K.10 With how many people did you discuss the experiment since flowering stage? ______________________________

K.11 With how many people did you discuss the type of seeds since you got them? ______________________________

K.12 With how many people did you discuss the type of seeds since you flowering stage? __________________

Risk preference experiment

The respondent is asked to choose between the different farming plots (plot 1 to plot 6); Each plot gives either the bad harvest yield or a good harvest yield. For instance, plot 2 gives 900 Shillings if the season is bad (bad harvest), but it gives 1800 Shillings if the season is good (good harvest).

Please read the following: Imagine you can select 1 of 6 plots. On plot one, you earn 1000 Tsh if the season is bad (HEAD) and also 1000 Tsh if the season is good (TAIL); on plot two 900 Tsh if the season is bad or 1800 Tsh if the season is good; on plot three 800 Tsh or 2400 Tsh; on plot four 600 Tsh or 3000 Tsh; on plot five 200 or 3600 Tsh and on plot six 0 or 4000. In each plot, there is a one chance in two to get the bad and good harvest, that is: a good season is as likely as a bad season. Please, take a moment to compare the six different plots and then tell me which plot is the best for you.

Show the boxes below to the farmers and explain him again how it works.

Plot 1.__	Plot 2.__	Plot 3.__	Plot 4.__	Plot 5.__	Plot 6.__
Bad harvest (Head) 1000	Bad harvest (Head) 900	Bad harvest (Head) 800	Bad harvest (Head) 600	Bad harvest (Head) 200	Bad harvest (Head) 0
Good harvest (Tail) 1000	Good harvest (Tail) 1800	Good harvest (Tail) 2400	Good harvest (Tail) 3000	Good harvest (Tail) 3600	Good harvest (Tail) 4000