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

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ABSTRACT

In this paper, we identify 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 social network by discussing with fewer people in the village the type of seed they received, so as not to reveal their improved seed. We also find that treated individuals reduced labor input by asking fewer people in the village to work on their farm during the growing season and, as a result, obtained fewer actual harvest gains.

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 experienced by its members. The more successful members 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

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[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 (1977) and Platteau (1991) refer to the concept of the 'moral economy.' Scott (1985) – cited in Platteau (2014) – notes that the poor are helped due to redistributive pressure rather than an altruistic desire to improve their conditions.
[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.

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underexplored research question is the extent to which this evasive response may correspond to ill-suited economic decisions. For instance, would individuals reduce economically profitable social interactions so as to prevent resource sharing with their social network? 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 that exploited the differential productivity of maize seeds. We randomly assigned to the treatment group a more productive, improved variety of maize. The control group received a common, traditional, lower yielding variety. According to agronomic trials in research stations the improved varieties of maize may produce yields up to five times larger than the traditional variety (Kanyeka et al., 2007). Improved maize thus substantially raises the expected harvest and so expected income of the treatment group as compared to the control group. We tested if the treated subjects altered some dimensions of their social interactions that would make their expected increased income known or visible to others.[5] We find that the individuals in the treatment group, as compared to the control group, informed fewer people in the village about the seeds they received and asked fewer people in the village for help on their farms.[6] We also find that these effects are greater when the ex-ante size of the participant's social network is larger, as measured by the number of relatives living in the village.[7]

Reliance on social networks for help on one's farm has potential economic implications. In rural Tanzania, like in many parts of the developing world, farming is usually a family business. All members of a household are, normally, involved in different farming activities (e.g., soil preparation, sowing, weeding, fertilizer application, harvesting and threshing). Village social networks are an effective way of expanding labor for the production process. We, indeed, find that the size of the network affects the quantity of maize harvested. While the improved seed does increase yields of the treatment group, this beneficial effect declines as the number of relatives in the village rise. This effect is not found for the control group with the traditional maize variety.

Our results contribute to two 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; Squires, 2016; Baland et al., 2016; Munshi and Rosenzweig, 2016). This paper provides field evidence showing that labor input is affected by redistributive pressure. 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 study area, key variables 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.

2. Description, design and procedures

We conducted a set of field experiments in fifteen villages located in two maize growing areas. One in the South-East (Morogoro) and in the other in the North (Karatu) of rural Tanzania. These villages may be thought of as fairly isolated, self-contained, units as they are situated 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 from becoming too disruptive to 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 that are 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 participant's network size is 9.2 relatives within the village (with a minimum of 0 and a maximum of 33) and 5.7 relatives in other villages. 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 household heads are female. The average farm size is 1.4 ha and 23% of households own an ox.

Bags containing 1 kg of improved maize seeds were randomly allocated to 47 percent of the sample. The control group received, instead, bags containing 1 kg of the traditional maize 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 m above sea level. 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 geographically scattered and are, on average, 25 min 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 min walk from the village while more than 20 per cent of the plots are located very far away, or more than 35 min walk.[12] All experimental plots had been utilized in the previous growing season also for maize. We can, therefore, rule out any strategic consideration in the choice of the plot.

Our key outcome variables are social interactions among people that would make the expected positive income shock known or visible. First,

[5] 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.

[6] The exact survey questions are respectively: *with how many people in the village did you discuss the type of seeds since you received them?* And *since you received the seeds, how many people from your village did you ask for help on your farm?* 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 in the paper.

[7] The exact survey question is: *how many of your relatives are living in this village?* The number of relatives living in the same village is our measure of social network. This is consistent with previous work (e.g., Bandiera and Rasul, 2006; Jakiela and Ozier, 2016). We use the terms number of relatives in the village, village network and social network interchangeably in this paper. For a comprehensive study on the relevance of family ties see Alesina and Giuliano (2014).

[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.

[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). More detail on the varieties and its adoption in rural Tanzania are reported in the online appendix.

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

Table 1
Variables definitions and summary statistics.

Variable	Definition and survey question	Mean	Standard Dev	Min	Max
Number of people with whom the type of seeds were discussed	Number of people in the village with whom the received seeds were discussed. D_i in the Equations (1) and (2). Survey question: With how many people in your village did you discuss the type of seeds since you received them?	2.85	2.35	0.00	10.00
Number of people you asked for help on your farm	Number of people in the village the farmer asked for help on the farm. A_i in the Equations (3) and (4). Survey question: Since you received the seeds, how many people from your village network did you ask for help on your farm?	1.9	2.76	0.00	20
Network size	Number of relative in the village as measure of the social network. N_i in the Equations (1)–(4). Survey question: How many of your relatives are living in this village?	10.5	10.97	0.00	72
Positive harvest shock	Randomly assigned treatment status (1 = improved variety; 0 = traditional variety). S_i in the Equations (1)–(4).	0.47	0.50	0.00	1.00
Expected sharing pressure	Number of people in the village you are expected to help. Survey question: how many people in this village do you expect to help, if they would be in need and if they asked you for help?	2.13	3.79	0	30
Number of people with whom you discussed land market issues	Number of people in the village with whom the farmer has discusses land market issues since the reception of the seeds. Survey question: Since you received the seeds, how many people in the village did you consult for information about land rental market (e.g., availability of tenants/landlords).	0.84	1.31	0.00	5.00
Number of people with whom you discussed agricultural practices	Number of people in the village with whom the farmer has discussed farming practices since the reception of the seed. Survey question: Since you received the seeds, how many people in the village you consulted for information regarding farming practices, new technologies, use of modern inputs such as fertilizer, etc.	0.89	1.12	0.00	5.00
Number of people with whom you discussed land issues	Number of people in the village with whom the farmer has discussed land issues since the reception of the seeds. Survey question: Since you received the seeds, how many people in the village did you consult for information about crop output markets	0.88	1.34	0.00	5.00
Harvest	Harvest from the experimental plot (in kilograms).	82.20	72.48	0.00	280.00
Network size outside the village	Number of relatives outside the village. Survey question: How many of your relatives are living outside this village?	7.16	9.99	0.00	73
Age of household head	Age of household head (in 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	If a member of the household has a leadership role in the community (1 = Yes; 0 = otherwise)	0.17	0.37	0.00	1.00
Female headed household	Gender of household head (1 = Female; 0 = otherwise)	0.11	0.32	0.00	1.00
Secondary education	Education level of household head. If 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 (in hectares)	1.41	0.92	0.00	4.05
Oxen	Do you own an ox? (1 = Yes; 0 = otherwise)	23%			
Labor	How many days in total have the members in your household worked on the experimental plot? (In man days)	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	Number of people in the village have asked the participant to help on their farm during the experiment. Survey question: Since you received the seeds, how many people from your village have asked you for help on their farm?	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%			

we measure the number of people in the village that the participant discussed the seeds with after she received them. This provides a direct measure of the inclination to share information about an expected positive income shock which could be affected by the size of the social network. The second key outcome variable is the number of people in the village that are asked to work on the participant's farm. This social interaction could also be affected by the size of the network; a larger network allows one to ask for more help from other (perhaps more productive) individuals. Assuming a constant marginal cost of asking for help, a larger network could induce more social interactions. Yet asking more people in the village for help entails both increased visibility and increased potential redistributive pressure.

2.1. *Asking for help on the farm and informal labor sharing agreements*

It should be noted that in our experimental context asking for help on the farm could be part of existing or new informal labor sharing agreements. These agreements are different from hiring labor on the local market at given wage and are normally made among individuals with strong social bonds (e.g., relatives). They imply working together in a set of manual agricultural activities such as field preparation, planting, weeding and harvesting. Labor sharing agreements are characterized by reciprocity, implying that a household that is invited to help expects to be reciprocated for a similar task and length of time, and/or will expect a share of the output as compensation. Social sanctions for not reciprocating can be harsh (Bevan and Pankhurst, 1996; Krishnan and Sciubba, 2009). There is, moreover, some anecdotal evidence that the agreements also have an important insurance component. In rural Tanzania, De Weerdt (2001) for instance reported that: 'a member who has to attend a funeral of a close relative, falls sick herself, or has to take care of a sick relative for a long time can be excused from her tasks, but still gets her fields attended to' (page. 24).

We have tested if the reciprocity (or exchanging labor) feature that characterizes labor sharing agreement is present in our sample.

We therefore tested if participant who are asking for help on their farm are more likely to help the others on their farms and vice versa. We found that this is the case. The correlation coefficient is 0.65 and statistically significant. Asking for help and offering help for farming plots with other people in the village are indeed strongly correlated.

2.2. 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 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 social 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 was undertaken with the randomly selected households. Their consent to participate in an agricultural experiment that entailed the distribution of maize varieties was explicitly requested. The baseline survey recorded all the relevant socio-economic information, agricultural characteristics of the farm and the plots. Each household provided information about the size of their village network, the type and frequency of actual and potential social interactions in their village.

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 the other farmers taking part in the experiment were 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. Meetings 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 agronomic information on soil and agricultural practices were collected.[15] Harvest of the experimental plot took place between July 2013 and August 2013. An 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. To control for risk aversion a simple incentivized risk experiment as in Binswanger (1981) was also administered. The protocols of the field experiment and risk experiment are provided in a separate online ap-pendix to this paper.

[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 some of their social interactions within their network. Our focus is on interactions that are more likely to make the others aware of their higher expected income either directly such as by discussing with others the seeds they have received or through on-farm interaction. Social interactions that capture this effect are discussions of 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 some interaction within their network by simply telling a smaller number of their peers about the seeds they received. We start with a simple regression where the dependent variable D_i is the number of people in the village with whom farmer i has discussed the type of seeds received.[16] The exact survey question (previously reported on the footnote 6) is: *with how many people in the village did you discuss the type of seeds since you received them?* The independent variable S_i is an indicator variable that takes value 1 if farmer i was randomly assigned to the improved seed group, otherwise (control group) is equal 0:

$$D_i = \beta_0 + \beta_s S_i + e_i \tag{1}$$

where e_i is the farmer i' s error term. We then add the network size in the village. This variable is constructed from the following survey question (previously reported on the footnote 7): *how many of your relatives are living in this village?* We further consider its interaction with the treatment (receiving improved seeds).[17] This interaction assesses if the evasive response is sensitive to the size of the network. We thus, estimate the following:

$$D_i = \beta_0 + \beta_s S_i + \beta_N N_i + \beta_I N_i \cdot S_i + e_i \tag{2}$$

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 then consider the effect of the same set of explanatory variables on the number of people in the village to whom farmer i has asked for help on the farm (defined as A_i). The exact survey question (also previously reported on footnote 6) is: *since you received the seeds, how many people from your village did you ask for help on your farm?*[18] As above, we test if the results are sensitive to the potential redistributive pressure that come from the size of the network. We therefore estimate the following equations:

$$A_i = \beta_0 + \beta_s S_i + e_i \tag{3}$$

$$A_i = \beta_0 + \beta_s S_i + \beta_N N_i + \beta_I N_i \cdot S_i + e_i \tag{4}$$

In all the estimations 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

[16] Please refer to Table 1 for a description of all the variables.

[17] It may be argued that the error term might be correlated with the social network size variable. Stratifying an exogenous treatment on endogenous variable, however, will yield valid estimate for the heterogenous effect. Nizalova and Murtazashvili (2016) 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.

[18] With high potential costs of not sharing resources – social stigma, social ostracism, evil eye (see, Platteau, 2000, 2014) – it is considered that subjects would not risk asking for help on any of their plots. With exposure comes increased likelihood that others might find out indirectly about the large positive expected increase in the harvest. Thus they would not strategically ask for support on some plots but not the experimental one.

Table 2
Social interactions in the village revealing the seed type.

Dep Vars	Number of people in the village with whom you discussed the seeds received			Number of people in the village you asked for help on your farm		
	Baseline	No controls	Controls and village FE	Baseline	No controls	Controls and village FE
	(a)	(b)	(c)	(d)	(e)	(f)
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.

household (dummy), education (dummy), risk aversion of the household head, land size, oxen (dummy) and 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).[19] We also control for reciprocity by including a variable that captures the number of people in the village that have asked the participant for help on their farm during the period of the experiment (see Table 1 for the exact survey question). This is a potentially important control as participants could ask for help with farming only because they want to be reciprocated or are already part of informal labor sharing agreements.

Lowering labor inputs have implication on the harvest amount. By asking for less help, farmers with improved seeds may thus not reap the full potential of the improved seeds. For instance, they would have less labor allocated to important agricultural practices such as soil preparation and weeding. Specifically, we test whether the positive expected harvest effect of improved seeds is sensitive to the potential redistributive pressure experienced by the farmer, as captured by the size of her social network. In order to test for this, we estimate a model similar to equation (2) except that the dependent variable is the harvest from the experimental plot instead of the number of people the participant discussed the seeds with or she asked for help.

4. Empirical results

Table 2 reports the results. The first two columns (a) and (b) report the results respectively for Equations (1) and (2). Column (c) reports the results after the inclusion of all the control variables. Columns (d) and (e) report the estimates for the Equations (3) and (4). Last column (column (f)) reports the results after the inclusion of the full set of controls. The baseline results reported in columns (a) and (d) show that compared to the control group, individuals assigned the improved seeds reduced their network interactions that would make others aware of their expected increase in harvest from the moment they received the seeds (by either avoiding to directly discuss their seeds or to ask for help on their farm). The estimated coefficient for the treatment variable (positive harvest shock) is indeed negative and statistically significant (at 10%) in both baseline regressions.

How does the size of the participant's village network affect these results? Column (b) and (e) in Table 2 present the results of the extended model including the effect of network size. We find that the effect of improved seeds on the number of people in the village 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 be asked to work on the 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 village social network the smaller the number of people in the village they discuss seed type with. This difference increases with network size. The same pattern applies to asking for help on the farm. These are important social interactions that would make the seed type and potential harvest gains 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 someone in her social network to 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 individuals. 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 result highlights that in the presence of a relatively large harvest shock (improved vs. traditional seed) the cost of the social ties, captured by the redistributive pressure, dominates over the benefits of social ties.[20]

Results are also quantitatively non trivial. Column (d), for instance, shows that on average, farmers with improved seeds asked 0.35 fewer people for help on the farm (significant at the 10% confidence level). Column (e) shows that the larger the network size, the fewer farmers with improved seeds asked for 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 a larger network. To illustrate, farmers with a village network of 20 people 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

[19] 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.

[20] 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.

Table 3
Dependent Variable: Harvest (in logs).

	Baseline (a)	No controls (b)	Controls (c)	Controls and village FE (d)
	(a)	(b)	(c)	(d)
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.

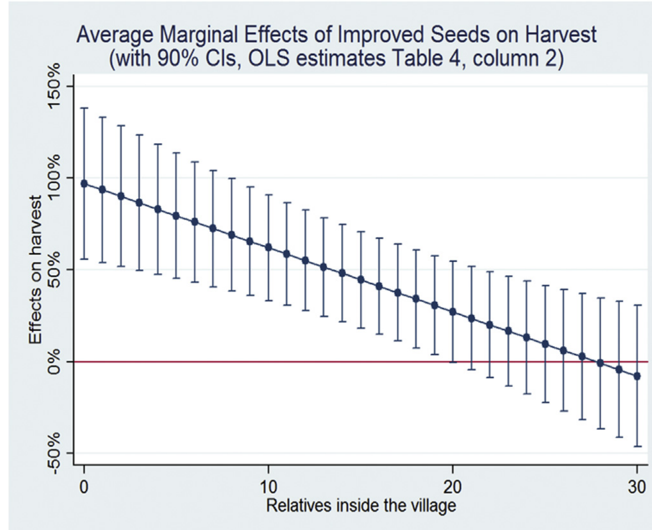

Fig. 1. Harvest vs Size of network.

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, in addition to region and village fixed effects. Results are reported on columns (c) and (f) 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.[21] 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 the observed behavior of reducing a potentially profitable social interaction, such as asking for help on the farm. We test for this by comparing harvest output between farmers with improved and traditional seeds at various network sizes. Results are robust to different specifications and are presented in Table 3.

On average, improved seeds increase expected harvest by 60%,[22] as shown in column (a). Furthermore, the size of the 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 social network (20 or more relatives in the village, i.e. 15% of the sample), the evasive behavior severely reduces the benefit of the improved seeds and can even completely cancel it out. These results are summarized in Fig. 1.

All regression results are presented with standard error robust to clustering at the village level and corrected for small cluster size (Cameron et al., 2008). Alternative specifications with standard clustering procedures and robust standard errors provide very consistent results and are also presented in Table A3. We also consider specifications with more interaction terms between controls affecting the network size (e.g., household size, reciprocity, leadership, education and assets) and the treatment variables are included. Results are very consistent and available upon request.

5. Robustness checks and extensions

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 of social interactions that do not directly involve discussing the new seeds or viewing the plot. We first tested our hypotheses on four social interactions that would be unlikely to inform others what seeds were used, i.e. implying no direct visibility. These are largely those that do not take place on the participant's experimental plot. These include general discussions on output markets, on land markets, and on farming practices (the detailed survey questions are reported on Table 1). Results are reported in Table 4.

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 that infer no direct visibility of the experimental plot. 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 relatives 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.

We find no statistical evidence of a similar effect on asking for help on the farm. This result highlights the importance of the visibility implied by the interaction with individuals living in the same village. One could argue that if the new improved seeds require less labor than traditional varieties then our interpretation could be muddied. Evidence suggests that in fact, the opposite may be true. 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 de 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

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

[22] The increase in the harvest found in our field experiment is smaller than the one found in the agronomic trials implemented in the agricultural research stations (see for instance, Kanyeka et al., 2007). This is because that in the latter, the growing conditions for the crop are optimal for instance in terms of soil moisture and nitrogen (Magorokosho et al., 2009). Our results are quite similar with a recent set of randomized controlled field trials undertaken by CIMMYT on this specific improved variety. The estimated productivity gain was between 70 and 90 per cent (Muricho et al., 2013).

Table 4
Social interactions in the village not revealing the seed type.

Dep. Var:	Number of people in the village with whom you discussed market issues			Number of people in the village with whom you discussed agricultural practices			Number of people in the village with whom you discussed land issues		
	Baseline	No Controls	Controls Village FE	Baseline	No Controls	Controls Village FE	Baseline	No Controls	Controls Village FE
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)
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 outside the village.

Dep Var:	Number of people outside the village with whom you discussed the seed type		Number of people outside the village you asked for help on your farm	
	Baseline	Controls and Village FE	Baseline	Controls and Village FE
	(a)	(b)	(c)	(d)
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? T-test results.

	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.

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, through simple differences in means, to rule out the hypothesis that improved seeds require less intensive farming practices. We find no evidence of such pattern. We report the results in the Table 6.

A critical issue is if the size of the network is an appropriate metric or proxy for the strength of 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 and they were in need*? This is a measure of potential (and not actual) social interactions with other farmers living in the same village.[23] We name this variable expected sharing pressure. Table 7 reports the results for the estimated models by using expected sharing pressure in place of network size.[24] Results are largely consistent. In fact, only the regression where the dependent variable is the number of people with whom the type of seeds were discussed displays much larger standard errors.

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 again very consistent with the pattern presented in Table 4.

It should be noted that 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 consistent to those in Table 2, illustrating changes in behavior that reveals seed type, as are reported in Table 8.

There are alternative interpretations that we cannot rule out for lack of appropriate data.[25] For instance, while the new improved seed requires more labor in equilibrium, it may still deliver a higher yield with the same amount of labor that is optimal with the traditional seed. It may not be, therefore, the fear of a redistributive family tax that prevents them from asking for help, but rather the fear of family pressure to work harder to deliver the maximum improved seed harvest gains. Hiding their seed type and accepting the yield of the improved variety under the more traditional labor input, may be a strategy to avoid this familial pressure. We also do not explore the role of envy from other people (also called "evil eye") as a result of exploiting the improved seed variety. A large extended family implies greater repercussions motivated by envy, which could result in destruction of property or malicious gossip, or even witchcraft punishments (as documented by Gershman, 2015, 2016; Giblin, 2005 cited in Platteau, 2014).

[23] The survey 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.

[24] 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.

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

Table 7
Social interaction in the village, harvest and expected sharing pressure.

	Number of people in the village with whom you discussed the seeds received		Number of people in the village you asked for help on your farm		Harvest (in logs)	
	No controls	Controls	No controls	Controls	No controls	Controls
	(a)	(b)	(c)	(d)	(e)	(f)
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
Other measures of network sharing pressure.

Dep Vars.	Number of network members with whom you discussed the seeds received		Number of network members you asked for help on your farm		Harvest (in logs)	
Alternative Network measure	Percentiles	Log (network size+1)	Percentiles	Log (network size+1)	Percentiles	Log (network size+1)
	(a)	(b)	(c)	(d)	(e)	(f)
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.

6. Concluding remarks

In this paper, we present empirical evidence of the economic implications of redistributive pressure in the developing world. We implemented a set of field experiments 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 less likely to discuss with other farmers their seeds, but also less likely to ask for less for help on the farm than the control group. This indicates that evasive responses may be made to avoid network redistributive pressures. Farmers that receive a relatively large positive income shocks prefer to reduce their visibility by reducing involvement with their village rather than face the risk of higher redistributive pressure and, as a result, obtain 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 paper, 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 redistributive pressure within social networks can compromise well-being: 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 social network will have fewer resources to share.

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Appendix A. Supplementary data

Supplementary data related to this article can be found at https://doi.org/10.1016/j.jdeveco.2017.12.001.

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