Risk Sharing Versus Unreciprocated Sharing in Social Networks*

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Abstract

Much of the empirical literature on risk-sharing within social networks does not distinguish between reciprocated and unreciprocated relationships. We recognize that some of these relationships may be true reciprocal risk-sharing relationships, while others may be unreciprocated, potentially altruistic, relationships. Previously, authors have found that transfers are more likely to occur between households of differing wealth and education levels, but we find this is only the case for unreciprocated transfers. Reciprocated, potentially risk-sharing, transfers are more likely to occur between households of similar wealth and education levels, and are more common among high wealth households. We also extend our analysis to indirect relationships, such as friends of friends, and find that the main results do not change as the length of the indirect chain considered increases.

1 Introduction

While informal insurance and social networks are important in all societies, they are even more critical in rural villages of developing countries. In these areas people know each other well and interact over generations. Many formal institutions which often serve the same functions as social networks in the developed world, such as health insurance and old age support, are lacking.

Townsend (1994), Jalan & Ravallion (1999), and Ligon et al. (2002), among others, document the importance of risk-sharing within villages as a whole. More recently, theorists have begun to model sharing that takes place within a network, rather than within the village as a unified whole (Bramoullé & Kranton 2007, Ambrus et al. 2008, Bloch et al. 2008). As researchers gain access to data sets with more detailed information about transactions

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between specific households, they have begun to show empirically the importance of risk-sharing within social networks. Udry (1994), Fafchamps & Lund (2003) and De Weerdt & Dercon (2006) give evidence that risk sharing takes place at the level of the network rather than the level of the village. These papers tend to find that negative income shocks experienced by an individual with whom the respondent is linked increase the gift giving and informal lending of that respondent.[1]

Recently researchers have begun looking at the determinants of the existence of risk-sharing links between households. Both the survey question used and the definition of a link differ across papers. Fafchamps & Gubert (2007) measure links in the Philippines by asking households who they could rely on in case of need or to whom they give help when called upon to do so. Note that this is one question, not two separate questions. Similarly, De Weerdt (2004) asked "Can you give a list of people, who you can personally rely on for help and/or that can rely on you for help in cash, kind or labour" in a Tanzanian sample. These questions do not allow the researcher to separate out giving help from receiving help. Santos & Barrett (2007) use data from Ethiopia where a link is measured asking people who they could rely on to ask for cattle as a gift, Because they only have data on 19 households, it is again difficult to separate relationships which involve only receiving from those involving both giving and receiving.

Each of these papers uses the existence of a link as the dependent variable, but defines a link slightly differently. Fafchamps & Gubert (2007) say that a directional link exists, or $l_{ij} = 1$, if household i says it would either give help to or receive help from household j. If household j does not list household i, then $l_{ji} = 0$. De Weerdt (2004) says a non-directional link $l_{ij} = l_{ji} = 1$ if either household says it would give help to or receive help from the other. The value of the link is 1 if only one household claims there is a relation and 2 if both households claim the existence of a link. Santos & Barrett (2007) say a directional link, $l_{ij} = 1$, exists if household i can rely on household j to gift them cattle.

Fafchamps & Gubert (2007) find that age differences, wealth differences, and geographic proximity[2] are good predictors of the existence of a link between two individuals. Links are more common between households which are more different in terms of wealth and age. They state on page 338 "younger heads of household are more likely to mention a link with an older household. This is consistent with the pooling of health risk, although it could also result from life cycle effects or intergenerational altruism. Wealth is also significant: consistent with expectations, households are more likely to mention as a source of insurance households that are richer than themselves." Santos & Barrett (2007) find that households of the same clan are more likely to have a link. De Weerdt (2004) finds that when two households have more friends in common, live closer to one another, are related, or are of the same religious affiliation, they are more likely to be linked. Households are also more likely to be linked when the two household heads are of a similar age (the opposite of Fafchamps & Gubert's (2007) result), and when household wealth is more dissimilar (similar

[1] Although this is often interpreted as evidence of risk-sharing, it might also be evidence of altruism.

[2] They measure geographic proximity using the difference between two households' walking distance to the road in minutes since they do not have GPS data.

to Fafchamps & Gubert's (2007) result).

All of these papers assume that the relationship between the two households is one of risk-sharing. They do not distinguish between reciprocated giving which goes in both directions (which may hint at risk-sharing) and unreciprocated giving which only flows from one household to the other. Unreciprocated transfers are less likely to be a sign of risk-sharing and may instead be a sign of charity or altruism. Foster & Rosenzweig (2001) study risk sharing under limited commitment between two households with symmetric levels of altruism. They show that if altruism is high enough, risk-sharing can break down as autarchy is no longer a credible threat. Transfers will tend to flow from the richer partner to the poorer partner.

Many papers have shown that transfers are motivated by both altruism and reciprocal risk-sharing. Leider et al. (2008) and Ligon & Schechter (2008) find that both directed altruism and reciprocity, where the decision-maker grants the partner a favor because she expects it to be repaid in the future, are important determinants of transfers. Lucas & Stark (1985) and Barr & Genicot (2008) find that both risk-sharing and altruism influence remittances in Botswana and risk sharing in Zimbabwe respectively. These last two papers do not allow for heterogeneous relationships, some with pure altruism and others with purely self-interested sharing.

Unreciprocated transfers are not necessarily a sign of altruism. They may also be a sign of a patron-client relationship. A wealthier household may help a poorer household in exchange for labor. These may also be transfers to households to discourage the recipient household from stealing from the giver (Schechter 2007).

In this paper we distinguish between reciprocated relationships which may involve risk-sharing and those which are unreciprocated. We find that risk-sharing links are qualitatively different from links involving unreciprocated sharing. Both links are more likely to be present when two households are related or live closer together. But, unreciprocated relationships are more likely to exist when the giver is wealthier and more educated than the recipient, potentially due to altruism. On the other hand, risk-sharing relationships do not depend on wealth differences and instead are more likely to occur between two wealthy households. Thus, previous results showing that households with differing levels of wealth are more likely to be linked should be interpreted in this light and future survey questionnaires should distinguish between the direction in which transfers move.

An additional contribution of this paper is that we do not limit ourselves to looking at bilateral relationships. We consider risk-sharing rings of various sizes, as well as unreciprocated chains of various sizes. When looking at bilateral relationships, two households which are direct relatives are more likely to be in both unreciprocated and reciprocated relationships with one another than two unrelated households. When allowing for rings and chains, we find that directly related households are more likely to be in reciprocal relationships with one another, but actually *less* likely to be in unreciprocated relationships with one another.

In Section 2 we discuss the data used in this analysis. Section 3 explains how we define bilateral links, reciprocal lending rings, and unreciprocated lending chains. Section 4 lays out the estimation strategy used while Section 5 presents the results. Section 6 concludes.

2 Data

In 1991, the Land Tenure Center at the University of Wisconsin in Madison and the Centro Paraguayo de Estudios Sociológicos in Asunción worked together in the design and implementation of a survey of 300 rural Paraguayan households in fifteen villages in three departments (comparable to states) across the country. The households were stratified by land-holdings and chosen randomly. The original survey was followed up by subsequent rounds of data collection in 1994, 1999, 2002, and, most recently, in 2007. All rounds include detailed information on production and income.

In 2007, new households were added to the survey in an effort to interview 30 households in each of the fifteen randomly selected villages for a total of 450 households. Villages ranged in size from around 30 to 600 households. In one small village only 29 households were surveyed. This round added many questions measuring networks in each village.

The process undertaken in each village was the following. We arrived in a village and found a few knowledgeable villagers to collect a list of the names of all of the household heads in the village. We then randomly chose new households to be sampled to complete 30 interviews in the village. (This meant choosing anywhere between 6 and 24 new households in any village in addition to the original households.) These villages are mostly comprised of smallholder farmers. There are no tribes, castes, village chiefs, moneylenders, plantation owners, or the like.

Our survey asks respondents from which households they would ask to borrow 20,000 Gs (approximately $4) if they had a personal problem, and then asks separately which households would ask to borrow 20,000 Gs from them if they had a personal problem. In order to make it easier for respondents to understand the question and so that all respondents interpreted it in the same way, we asked about this one very specific interaction. This amount is much smaller than that which formal institutions will lend. The lowest amount lent to a survey respondent from a formal institution is 100,000 Gs while the median is 2,500,000 Gs. Many authors have shown that such informal credit is a form of risk-sharing, as lending and repayment often depend on shocks received by both borrower and lender (Platteau & Abraham 1987, Udry 1994, Ligon et al. 2002).

Respondents could list as many households as they wanted, and listed anywhere from 0 to 14 for who they would go to (with a median of 2) and anywhere from 0 to 32 (also with a median of 2) for who would go to them. There are 1113 total instances of another household being listed as a source to borrow from, and 1086 total instances of another household being listed as a possible recipient of lending. Of the households listed as potential lenders, 48.9% of them were also listed as potential borrowers by the listing household. Of those listed as potential borrowers, 50.1% were also listed as potential lenders by the listing household.

There are 947 unique households mentioned by respondents as either a potential borrower or a potential lender. Adding in the 188 survey respondents who are not themselves listed by someone else (but may have listed someone), we have 1135 potential network members. We have survey data on 39.6% of these network members.[3] Since the relevant unit of observation

[3]The 449 survey respondents listed 947 unique households. 261 of the households listed were themselves

is the dyadic link between households, our sample will consist of all links between those households for which we have survey data.

3 Defining Links

In this paper we look at three types of links between households. Let us call the first type a standard link (S-link). We consider $S_{ij} = 1$ if household i either lists household j as a source to borrow from or lists household j as a household they would lend to. This is the type of link which was analyzed in Fafchamps & Gubert (2007). The direction of this link is determined by which household lists the other, not the direction of possible transfers. Of the 2199 links listed by respondents, 661 are between two households who have both been surveyed. Of these, 227 indicate that i would both borrow from and lend to j, 183 indicate only that i would lend to j, and 251 indicate only that i would borrow from j. The S-links do not distinguish between these 661 links.

We also look at links we call lending links (L-link). In this case $L_{ij} = 1$ if household i says it would lend to j, *or* household j says it would borrow from i. The direction of this link is determined by the direction that households expect transfers to flow, regardless of which household mentions that the link exists. We divided these L-links into reciprocated and unreciprocated links. Reciprocated lending links (LR-links) are those for which $L_{ij} = \mathrm{L}_{ji} = 1$ while unreciprocated lending links (LU-links) are those for which $L_{ij} = 1$ while $L_{ji} = 0$. Of the 748 links for which $L_{ij} = 1$, 434 links (217 pairs) are reciprocated while 314 are unreciprocated.

3.1 Lending Rings

Direct bilateral links between households do not provide a full picture of the sharing network that exists within a community. The amount of credit available through a network will depend on the nature not just of a household's immediate links but of the overall network shape. If a household's immediate network is not able to provide sufficient lending, then that household's friends may in turn use their own friends to gather funds. Thus, households may be helped by friends of friends. This lending may occur either with funds transferred first from the friend of the friend to the friend and from there to the original household. It may also be done by the friend vouching for the original household so that the friend of the friend lends to the original individual directly. to the wealthy partner. In either case, the value of a link includes not just the physical resources of the link partner but also the access it provides to other households in the network. The exact mechanics of such benefits are discussed in Leider et al. (2008) and Möbius & Szeidl (2008).

In this model, individual i wishes to borrow money from individual k. However, i and k do not know each other well, and so k is not willing to make the loan. This can be resolved by an intermediary j who is willing to lend to i and whom k trusts. As long as j values his

survey respondents. Fafchamps & Gubert (2007) survey 206 respondents who report 939 unique households, of which 189 were themselves survey respondents.

friendship with k and i values his friendship with j, the contract can be self-enforcing. That is, if k does not recover the loan from i, he will sever his ties with j. Individual j would in turn sever his ties with i. Knowing this, k no longer fears that i will abscond with the money and is willing to agree to the transaction. Under similar conditions, the loan could also be arranged by j borrowing the amount from k (not necessarily disclosing the reason why) and in turn creating a new loan from j to i. Again, this system works because k trusts j to pay back the loan and j trusts i, making it unnecessary for k to directly trust i.

The weakest relationship between k and i would be analogous to our unreciprocated link. And like our links, if the relationship between k and i also allows for lending from i to j to k (or from i to k to j), this relationship becomes like our reciprocated link. So, we generalize our link definitions to include indirect links that involve more than just two households. Thus, if we believe that a significant amount of informal borrowing takes place via intermediaries, we are able to determine the robustness of our results as we loosen our definition of what a link entails.

In this example, individuals i, j, and k are involved in a risk-sharing relationship of size 3. Specifically, we define two households i and j to share an LR-link in a ring of size N if we can trace a path from i to j to i that consists of no more than N links. The 217 bilateral LR-links mentioned above are identical to the set of links we obtain when we set $N = 2$. In order to provide a direct comparison, we also compute the number of unreciprocated LU-links that exist in chains. A link from i to j is classified as an LU-link in a chain of size N if we can trace some path from i to j consisting of no more than $N - 1$ links and i and j are not part of an LR-link of size N. The -1 is necessary to limit unreciprocated links to those that could potentially become reciprocated if one or more links were placed appropriately. This implies that the set of 314 LU-links we found when looking at bilateral relationships are identical to the set of LU-links under this definition when we set $N = 2$.

When looking at rings of sizes greater than 2, we may find that two households which did not seem to have any relationship at all, are actually involved in a risk-sharing ring. For example, if household i lends to j, j lends to k, k lends to m, and m lends to i, when looking at rings with $N = 2$ we would not think that i and k are connected, but when looking at rings with $N = 4$ we would realize there is a relationship.

Because we do not have a census of all households, we can not perfectly capture all such lending rings. Here, we make use of the households that are listed as a potential borrowing or lending partner but are not directly surveyed. If i lends to j, j lends to k, and k lends to i, we include the reciprocated link between i and j even if we do not have survey information on k.[4] As stated above, the number of pairs of households in LR-links in rings of size $N = 2$ is 217; the number of pairs of households in LR-links in rings of size $N = 3$ is 326; and the number increases up to a maximum of 1625 pairs of households in LR-links in rings of size $N = 15$.[5] Increasing rings to sizes larger than this does not increase the number of links.

As mentioned before, there are 314 LU-links of size $N = 2$. The number of LU-links is

[4]This will lead to some selection issues in the larger rings. Since we surveyed 30 households in each village, we will be less likely to find lending rings in the larger villages due to the larger number of unsampled households.

[5]Keep in mind that 1625 pairs of households means 3250 links.

1479 under chains of size $N = 3$, and 1612 under chains of size $N = 12$. Unlike LR-links, the number of LU-links does not necessarily increase with chain size; the maximum number of LU-links occurs at $N = 5$, with 2229 links. There are no additional changes in the number of LU-links past chains of size 12.

4 Empirical Estimation

In this section we model the prediction of the existence of standard links and both reciprocated and unreciprocated lending links. From the 445[6] observations there are 12,762 possible relationships.[7] This is fewer than the 197,580=445*444 we would obtain if we allowed for every possible link between households. This is because the 15 villages are not close to one another and so households in a village do not know households in the other villages.

In all regressions we include the geographic distance between the two households and whether the two households are immediate relatives (that is, parents, children, or siblings but not uncles, cousins, or grandparents). These are characteristics of the relationship between the pair of individuals, not household-level characteristics.

We also make use of some household-level characteristics. For the two directional links (the standard links and the unreciprocated links) we include the sum $(x_i + x_j)$ and the difference $(x_i - x_j)$ of each of the household characteristics as explanatory variables.[8] For the reciprocated links, symmetry implies not only that there are half as many observations (since a link from i to j implies a link from j to i), but also that the absolute value of the difference $(|x_i - x_j|)$ must be used rather than the difference.

The household characteristics which we include are the maximum years of education in the household, the age of the household head, the number of working age people in the household, the share of income coming from agriculture, the number of disabled people in the household, the number of days anybody over 10 years old and not disabled was sick enough to miss school or work, and the log of wealth (which includes the value of land, animals, and tools owned but not consumer durables or education). We also include village fixed effects. Table 1 shows summary statistics of the households, while Table 2 shows summary statistics of the dyads.

The standard errors of the regressions must take into account that dyadic observations are not independent due to individual-specific factors common to all observations involving that individual. We use the dyadic standard errors suggested by Fafchamps & Gubert (2007). They assume that $E[u_{ij}, u_{ik}] \neq 0 \forall k$ and $E[u_{ij}, u_{kj}] \neq 0 \forall k$. Likewise, $E[u_{ij}, u_{jk}] \neq 0$

[6]Depending on the measure of agriculture income used, some households had to be dropped due to incomplete data.

[7]There are 5,946 possible relationships for the LR-links. This is due both to the halving of observations mentioned previously and the fact that one village had to be dropped due to a complete absence of LR-links. When that village is dropped from the S-link and LU-link regressions, there are no qualitative changes to the results.

[8]We also ran our regressions with the squared value of each of these terms. However, the squared terms were almost never significant and did not have qualitative impacts on the other regression coefficients.

and $E[u_{ij}, u_{ki}] \neq 0$. Fafchamps & Gubert (2007) extend the method that Conley (1999) developed to deal with spatial correlation. The formula they suggest for the network-corrected covariance matrix is

$$\text{AVar}(\hat{\beta}) = \frac{D}{D-K}(X'X)^{-1}\left(\sum_{v=1}^{V}\left(\sum_{i=1}^{N_v}\sum_{j=1}^{N_v}\sum_{k=1}^{N_v}\sum_{l=1}^{N_v} m_{ijkl}^{v} X_{ij}^{v'} u_{ij}^{v} u_{kl}^{v} X_{kl}^{v}\right)\right)(X'X)^{-1}$$

where $m_{ijkl} = 1$ if $i = k$, $j = l$, $i = l$, or $j = k$, and 0 otherwise.[9] There are K regressors and D dyadic observations on pairs of households.[10] There are N_v households observed in each village v. All observations where $i = j$ or $k = l$ are omitted. This formulation of standard errors allows us to account for both heteroskedasticity and cross-observation correlation.

5 Results

Table 3 shows the correlates of three types of links: the standard links (S), the unreciprocated lending links (LU), and the reciprocated lending links (LR). Our results obtained using S-links appear to generally agree with those found by Fafchamps & Gubert (2007). Like them, we find that households which live closer to one another or are directly related to one another are more likely to be linked. This may be due to the lowering of informational asymmetries in risk-sharing and altruistic relationships when households live closer and are related. Monitoring is less costly among such households. On the other hand, covariate risks are probably larger when households live closer to one another. But, since we look only at networks within villages, we are unlikely to see households diversifying risk over larger distances in our data.

We use the share of agricultural income in total income to test whether households which are more or less dependent on agriculture as their main source of income are more or less likely to be linked. Theory would predict that households will want to reduce covariate risk by linking with households which have different earning portfolios. On the other hand, it may be easier for a farmer to monitor another farmer than for a farmer to monitor a fisher. We find no significant relationship between agriculture share and the probability of a link.[11] Likewise, Fafchamps & Gubert (2007) find that income correlations between households do not predict the existence of a link in their data.

Perhaps most importantly, likeDe Weerdt (2004) and Fafchamps & Gubert (2007), we also find that wealth differences have a significant negative impact on the probability of a standard S-link. Poorer households are more likely to list richer households. However, upon separating our observations into the reciprocated and unreciprocated links, we see that

[9] To use this formula in a logit regression, $(X'X)^{-1}$ must be replaced by an expression that depends on the scores.

[10] We would have $D = N^2 - N$ if all households could have a relationship with all other households except for with themselves. But, households in different villages are assumed not to have relationships with one another (and do not in practice).

[11] We also tried breaking down agricultural income into that which comes from crops and that which comes from animals, but again we found no significant relationship.

each of those links depends on different factors. The reciprocated links appear to depend even more strongly on the sum of wealth; two wealthy households are more likely to be involved in a reciprocal relationship. The unreciprocated links depend less strongly on the sum of wealth but more so on wealth differences. We see that the sign of the coefficient on wealth differences flips and the coefficient increases in magnitude between the S and LU regressions. This implies that, although poor households are more likely to list rich households, the direction of unreciprocated aid is more likely to be from rich to poor.

Additionally, educational differences appear negative and insignificant when the estimation is done using standard links, yet we find that more educated households are more likely to have unreciprocated relationships being willing to transfer money to less educated households. This suggests that the conflation of different kinds of links can have a strong effect on what is considered an important covariate. Previous results in the literature finding that households of different wealth and education levels are more likely to be linked may be concentrating on unreciprocated altruistic relationships. When distinguishing between those links, and reciprocated risk-sharing links, we find that wealthier and more educated households are more likely to be involved in such relationships. The bigger the difference in wealth level between the two households, the less likely they are to have a reciprocal risk-sharing relationship.

5.1 Lending Rings

Multiple papers, including Bloch et al. (2008) and Niehaus (2008), discuss how second-order and higher links determine such things as the viability of collective punishment and diffusion of information. By examining the evolution of regression coefficients as ring size changes, we can recover new information about the functioning of the network.

In our data, increasing the possible size of rings reveals a very rich structure within villages, with new relationships appearing and old relationships changing their nature up to rings of size 15. Tables 4 and 5 present the regression coefficients for reciprocated rings and unreciprocated chains of sizes 3, 6, and 9. These results are largely representative of the change in coefficients with the general progression of changes in ring sizes.

As we broaden our definition of what is considered a reciprocated relationship in Table 4, we do not see large changes in what factors are considered important. Wealthier households continue to be more likely to be involved in reciprocal relationships, and distance and family relations are considered significant throughout. Wealth differences become insignificant, so when including larger lending rings we do not find any tendency for relationships to be less common between households of different wealth levels. One possible reason for this is that small risk-sharing rings of two or three households, consist of households of similar wealth levels. Lending rings of 6 or 9 households may begin to include households of more disparate wealth levels. It remains to be seen whether transfers can travel such long distances.

Table 5 shows that the unreciprocated chains of transfers, however, behave very differently. Whereas unreciprocated bilateral links of size 2 were common between family, when we increase chains to those of size 3, the family relationship's importance shrinks. Including longer chains causes the coefficient to change sign and regain significance. Family are

significantly less likely to be involved in unreciprocated chains.

Unreciprocated links can only become more common by linking previously unlinked households, and can only become more scarce by converting a link which seemed to be unreciprocated into a reciprocated one. If the coefficient on 'immediate family' switches sign from positive to negative with increases in chain size in the LU regression, it must mean that the net increase in links among family members is much smaller than the net increase in links among unrelated households. This could be because family members participate in reciprocal lending rings which appear unreciprocated when looking only at bilateral links. This would mean that family relationships which appeared unreciprocal at the bilateral level, are actually part of larger chains of reciprocated giving. It could also be because family members link both with each other, and with non-family members. As the chain size increases, links between unrelated households become more and more likely.

Distance also becomes less significant as rings increase in size. Households which are closer to one another are more likely to be in reciprocal lending rings, but no more likely to be in unreciprocal lending chains. This would make sense if everyone has an unreciprocated link with one of his neighbors. As one increases chain length, distance between linked households will increase.

The difference of wealth, however, continues to not only remain highly significant, but stays of a similar magnitude. Unreciprocated relationships involve richer households transferring money to poorer households. The effects of difference in education also remains significant and of stable coefficient. So, as chain size increases, we still find our main result that unreciprocated relationships are more likely to flow from rich households to poor households, while reciprocated relationships are more likely between richer households. [12]

One possible reason why there are more changes in the unreciprocated LU regressions than the reciprocated LR regressions as rings size increases is the nature of the classifications used. Once two households are in a reciprocated sharing relationship, an increase in ring size will not change this. That is, the set of household pairs with reciprocated sharing for a ring of size N is always a subset of those with reciprocated sharing for ring size $N + 1$. However, as chain size increases, households with unreciprocated sharing may change their status to reciprocated sharing, and so the set of unreciprocated sharing links may be more volatile than the set of reciprocated links.

Whether or not lending rings are useful for making economic transfers is an open question. The costs of sending transfers from one individual to another indirectly vis-a-vis multiple people may be high, and may create incentives for defecting (Bloch et al. 2008). That said, if creating links is also costly, indirect relationships may be a cost-effective way of transferring money without forming many new bilateral relationships.

[12]For comparison with the analysis for rings of size 2, we show the results for S-link lending rings in table 6 and find that the results for immediate family and distance do not change with ring size. The results for wealth levels lose significance as ring size increases. Remember that an S-link exists from household i to j if household i lists household j, regardless of the direction of the monetary transfer, so it is harder to interpret changes in these coefficients.

5.2 Comparison of Stated and Actual Links

The analysis thusfar has defined a link as existing when one household states that it would ask to borrow money from another household in times of need or the household would borrow from it (a stated link). We also have data on which households the respondents actually borrowed from or lent to in the past year, in addition to transfers of agricultural produce in the past year and gifts of money to cover health expenses in the past year. We now verify that these stated links actually have economic meaning for daily transactions.

A bit more than half of all gifts and loans in the past year come from individuals who households say they would go to or would go to them if they needed help. There are 430 directed links involving gifts and loans over the past year. Of those, 219 (51%) are links which were mentioned by respondents as someone to whom they could go to for help or who would go to them. (There are 736 links which are listed as someone to whom they could go to for help or who would go to them for help, but this does not mean it would have been necessary to do so in the past year.)

The above discussion does not distinguish between reciprocated and unreciprocated relationships. A bit more than half of the gifts and loans which were reciprocated in the past year come from somebody with whom the household states having a reciprocal relationship. Of the unreciprocated gifts and loans, a bit less than a quarter come from a household with whom they state having a reciprocal relationship, and a bit less than a quarter come from a household with whom they state having an unreciprocal relationship. It may be the case that households have potentially reciprocal relationships with one another as mentioned by whom they *would* go to for help, but that in any given year that relationship may not actually be reciprocated. Thus, seemingly unreciprocated transfers may be part of reciprocal relationships. This suggests one disadvantage of empirical work using data on actual rather than potential transfers.

So far, we have combined actual gift-giving relationships and actual lending relationships, whereas the hypothetical questions asks about lending only. When looking at only the gift-giving relationships, we find that there are 350 directed links involving gift-giving over the past year. Of those, 48% are links which were mentioned by respondents as someone with whom they stated having a lending relationship. There are 120 directed links involving loans over the past year. Of those, 73% are links which were mentioned by respondents as someone with whom they stated having a lending relationship.[13] So, the hypothetical links we have been looking at thusfar do have economic meaning for daily interactions and are more relevant for lending transactions than for gift transactions.

In addition, we can run two types of regressions checking the validity of the stated data. We can first check if the predictors of stated links (both reciprocated and unreciprocated) are the same as the predictors of actual links by running regressions with the same regressors as before but where actual links are the dependent variable rather than anticipated links. We can then add to that regression anticipated links as additional explanatory variables to test whether they have additional predictive power.

[13]The hypothetical questions were asked at the beginning of the interview, while the actual lending questions were asked towards the end of a 2-3 hour interview.

These regressions are found in Table 7. The first four columns look at the determinants of giving and lending relationships which were unreciprocated in the past year, while the two after that look at the determinants of giving and lending relationships which were reciprocated in the past year. The final four columns looks at the determinants of all directional relationships in the past year, whether or not they were reciprocated.[14]

We find that the wealth results using stated links continue to hold with actual links. Unreciprocated actual transfers are more likely to flow from wealthier to poorer households. Reciprocated actual transfers are more likely to flow between two wealthier households. When not distinguishing reciprocated and unreciprocated transfers, both the sum and difference of household wealth have significant coefficients. The qualitative results in which the dependent variable is the value of the transfers rather than a binary variable indicating whether or not a transfer took place are quite similar.

Also, we find that stated links are an extremely significant predictor of actual links. Unreciprocated stated links are stronger predictors of unreciprocated actual transfers, while reciprocated stated links are stronger predictors of reciprocated actual transfers. These variables have significant coefficients even when including all of the other explanatory variables. This suggests that we are not capturing all of the determinants of links, and that these potential links have economic meaning above and beyond simply predicting the characteristics of linked households.

6 Conclusion

We look at lending and transfers within social networks and distinguish between relationships in which transfers go only from one household to the other, and relationships in which transfers can go in both directions. We find that the determinants of these two types of relationship are quite different. Unreciprocated transfers are more likely to be sent from wealthier households to less wealthy households. Reciprocal relationships are more likely to occur between wealthier households of similar wealth levels.

This suggests that distinction is important and needs to be taken into account in empirical analyses. The findings that households transfer more when the households they are linked with have negative shocks, or that households of different wealth and education levels are more likely to be linked, need not suggest that these relationships are necessarily risk sharing relationships. If the relationships are not reciprocated they may be altruistic relationships or patron-client relationships rather than risk-sharing relationships.

We might worry that a seemingly unreciprocated relationship from household i to household k is actually reciprocal if i lends to k who lends to j who lends back to i again. We thus look more carefully at indirect relationships in addition to direct bilateral relationships. We find that most of the determinants of indirect relationships are the same as the determinants of the direct relationships, and specifically, the results on wealth differences and wealth sums do not change much. This suggests that the differentiation between reciprocated and

[14]This is not the same as an S-link, since in this case the direction is based on the flow of money, not based on which household mentions the other household.

unreciprocated relationships is relatively robust, and is not due to looking only at bilateral relationships.

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Table 1: Household Statistics

Variable	Mean	Standard Deviation
Household Wealth	32655.74	138246.83
Log Household Wealth	8.54	1.89
Years of Education	8.26	3.72
Age of Household Head	53.73	14.53
Agriculture Share	0.62	0.28
Livestock Share	0.30	0.21
Adult Members	2.32	1.16
Disabled Members	0.29	0.56
Days Sick	23.30	45.04
Households	445	
Villages	15	

Wealth is calculated in USD using the exchange rate of 5300 PYG to 1 USD.
Note that the sample of households for which we have livestock data is slightly different than the sample for which we have agriculture data.

Table 2: Link Statistics

	Difference of		Absolute Difference of		Sum of	
Variable	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
Household Wealth	0	186791.34	48154.30	180477.12	66821.45	205443.31
Log Household Wealth	0	2.37	1.77	1.58	17.09	3.00
Years of Education	0	5.10	3.96	3.22	16.53	5.42
Age of Household Head	0	20.04	16.01	12.05	107.48	20.98
Agriculture Share	0	0.38	0.30	0.23	1.23	0.40
Livestock Share	0	0.29	0.22	0.19	0.60	0.31
Adult Members	0	1.61	1.19	1.09	4.65	1.68
Disabled Members	0	0.79	0.47	0.64	0.58	0.79
Days Sick	0	63.80	36.20	52.53	46.51	63.36

Variable	Mean	Std. Dev.
Immediate Family	0.03	0.17
Distance in Km	1.91	1.57
Households	445	
Villages	15	
Possible Links	12762	
Standard Links	653	
Reciprocated Links	312	
Unreciprocated Pairs of Links	212	

Wealth is calculated in USD using the exchange rate of 5300 PYG to 1 USD.
Note that the sample of households for which we have livestock data is slightly different than the sample for which we have agriculture data.

Table 3: Basic Regressions

Variable	S-Link	Dyadic t-value	LU-Link	Dyadic t-value	LR-Link	Dyadic t-value
Immediate Family	1.782***	8.61	1.038***	4.54	1.796***	6.43
Distance in Km	-1.792***	-10.77	-1.239***	-7.82	-2.217***	-8.87
Difference of						
Log Household Wealth	-0.067**	-1.99	0.310***	8.00	-0.176*	-1.67
Years of Education	-0.005	-0.37	0.056***	3.49	-0.016	-0.56
Age of Household Head	-0.002	-0.48	-0.012***	-3.08	-0.007	-0.89
Agriculture Share	0.086	0.49	0.105	0.44	0.124	0.25
Disabled Members	-0.033	-0.97	-0.019	-0.42	-0.001	-0.01
Adult Members	0.024	0.31	0.117	1.21	-0.153	-0.55
Days Sick	0.000	-0.15	0.002	1.52	0.004	1.22
Sum of						
Log Household Wealth	0.193***	4.58	0.107***	2.69	0.307***	5.03
Years of Education	0.019	1.29	0.005	0.30	0.039*	1.88
Age of Household Head	-0.008*	-1.92	-0.008*	-1.82	-0.011	-1.47
Agriculture Share	0.527**	2.10	0.374	1.56	0.620	1.63
Adult Members	0.101**	2.54	0.039	0.83	0.194**	2.38
Disabled Members	0.197**	2.33	0.201**	2.33	0.322	1.55
Days Sick	0.000	0.31	0.001	0.73	-0.004	-1.11
Households	445		445		415	
Villages	15		15		14	
Potential Links	12762		12762		5946	
Actual Links	653		312		212	

Village fixed effects are included in the estimation but not shown here.
Village 75 was excluded from the reciprocated sharing regression due to an absence of such links.
S-Links are the standard undifferentiated links between households. LU-Links represent unreciprocated sharing, while LR-Links represent reciprocated sharing between households.
'Absolute Difference' is used instead of 'Difference' for the LR-Link regressions.
*,**, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

Table 4: Reciprocated Rings of Size 3, 6, and 9

Variable	LR-Link	Dyadic t-value	LR-Link	Dyadic t-value	LR-Link	Dyadic t-value
Immediate Family	1.719***	6.71	1.636***	5.01	1.351***	3.85
Distance in Km	-2.116***	-9.49	-1.072***	-6.93	-0.590***	-4.65
Absolute Difference of						
Log Household Wealth	-0.159**	-2.02	0.004	0.06	-0.020	-0.30
Years of Education	-0.038	-1.62	-0.041	-1.12	-0.069*	-1.88
Age of Household Head	-0.010	-1.63	-0.004	-0.63	-0.003	-0.55
Agriculture Share	0.123	0.36	0.365	1.18	0.103	0.31
Adult Members	-0.035	-0.42	-0.020	-0.20	-0.060	-0.57
Disabled Members	-0.022	-0.09	-0.093	-0.74	0.146*	1.66
Days Sick	0.004	1.17	0.003	1.52	0.002	0.82
Sum of						
Log Household Wealth	0.256***	4.79	0.219***	3.39	0.154**	2.24
Years of Education	0.030	1.45	0.040	1.19	0.055	1.56
Age of Household Head	-0.010*	-1.64	-0.007	-0.99	-0.007	-0.90
Agriculture Share	0.751**	2.13	0.560*	1.75	0.369	1.13
Adult Members	0.227***	3.29	0.194**	2.09	0.216**	2.17
Disabled Members	0.182	0.87	0.232	1.28	0.207	1.18
Days Sick	-0.005	-1.29	-0.006**	-2.46	-0.006***	-2.59
Households	415		415		415	
Villages	14		14		14	
Possible Links	5946		5946		5946	
Actual Links	326		1203		1526	
Maximum Ring Size	3		6		9	

Village fixed effects are included in the estimation but not shown here.
Village 75 was excluded from the reciprocated sharing regression due to an absence of such links.
*,**, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

Table 5: Unreciprocated Chains of Size 3, 6, and 9

Variable	LU-Link	Dyadic t-value	LU-Link	Dyadic t-value	LU-Link	Dyadic t-value
Immediate Family	-0.015	-0.07	-0.764***	-3.25	-0.346*	-1.65
Distance in Km	-0.750***	-8.59	-0.049	-0.78	-0.084	-1.51
Difference of						
Log Household Wealth	0.177***	6.45	0.144***	4.26	0.181***	3.96
Years of Education	0.046***	4.29	0.041**	2.31	0.048**	2.10
Age of Household Head	-0.005	-1.49	-0.007	-1.57	-0.009*	-1.66
Agriculture Share	0.040	0.27	0.037	0.17	0.204	0.70
Adult Members	-0.008	-0.25	0.030	0.56	0.051	0.74
Disabled Members	0.018	0.25	0.103	1.13	0.171	1.42
Days Sick	0.000	-0.26	-0.002	-1.41	-0.003*	-1.73
Sum of						
Log Household Wealth	0.121***	3.43	-0.021	-0.65	-0.023	-0.72
Years of Education	0.015	1.10	0.036***	2.82	0.041**	2.55
Age of Household Head	-0.003	-1.01	-0.003	-0.73	0.000	-0.03
Agriculture Share	0.309*	1.69	0.241	1.40	0.399*	1.95
Adult Members	0.037	0.95	-0.051	-1.33	-0.070	-1.55
Disabled Members	0.028	0.37	0.091	1.29	-0.014	-0.17
Days Sick	0.000	-0.08	0.000	-0.48	0.000	-0.31
Households	445		445		445	
Villages	15		15		15	
Possible Links	12762		12762		12762	
Actual Links	1479		2025		1762	
Maximum Ring Size	3		6		9	

Village fixed effects are included in the estimation but not shown here.
*,**, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

Table 6: Indirect Standard Links

Variable	S-Link	Dyadic t-value	S-Link	Dyadic t-value	S-Link	Dyadic t-value
Immediate Family	1.539***	6.58	1.486***	5.28	1.576***	5.30
Distance in Km	-1.263***	-8.97	-0.803***	-6.86	-0.741***	-5.96
Difference of						
Log Household Wealth	-0.074**	-2.22	-0.054	-1.44	-0.055	-1.43
Years of Education	-0.009	-0.62	0.019	0.89	0.027	1.14
Age of Household Head	-0.004	-0.95	-0.010**	-1.99	-0.009	-1.63
Agriculture Share	0.248	1.37	0.509**	2.12	0.594**	2.31
Adult Members	-0.039	-0.97	-0.071	-1.09	-0.073	-1.04
Disabled Members	0.054	0.59	0.242**	2.10	0.217*	1.75
Days Sick	0.001	0.98	0.001	0.65	0.000	0.08
Sum of						
Log Household Wealth	0.144***	3.17	0.073	1.33	0.054	0.97
Years of Education	0.005	0.29	0.000	0.00	0.002	0.08
Age of Household Head	-0.001	-0.16	-0.007	-1.22	-0.008	-1.39
Agriculture Share	0.541**	2.18	0.521*	1.79	0.436	1.40
Adult Members	0.101**	2.16	0.029	0.43	0.035	0.53
Disabled Members	0.087	0.87	0.068	0.53	0.076	0.56
Days Sick	-0.001	-0.57	0.000	0.09	0.000	0.07
Households	445		445		445	
Villages	15		15		15	
Possible Links	12762		12762		12762	
Actual Links	1602		3085		3226	
Maximum Ring Size	3		6		9	

S-Links are the standard undifferentiated links between households.
Village fixed effects are included in the estimation but not shown here.
*,**, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

Table 7: Actual Giving and Lending

Variable	Unreciprocated Giving and Lending		Unreciprocated Lending Only		Reciprocated Giving and Lending		Any Giving and Lending		Any Lending Only	
Immediate Family	1.371***	0.954***	1.477***	0.603*	2.401***	1.925***	2.005***	1.561***	1.406***	0.543**
	(6.84)	(4.55)	(5.12)	(1.95)	(7.70)	(6.28)	(9.93)	(7.61)	(5.03)	(2.04)
Distance in Km	-1.272***	-0.985***	-1.463***	-0.658**	-1.992***	-1.391***	-1.478***	-1.076***	-1.478***	-0.689***
	(-6.93)	(-6.10)	(-3.86)	(-2.42)	(-5.08)	(-3.80)	(-8.31)	(-7.03)	(-4.39)	(-2.65)
Stated LU-Link		1.711***		3.048***		1.278***		1.691***		2.867***
		(8.88)		(8.54)		(4.80)		(9.83)		(8.75)
Stated LR-Link		1.234***		2.990***		2.237***		1.840***		2.981***
		(6.08)		(8.11)		(5.73)		(9.29)		(8.38)
Difference of										
Log (Hh Wealth)	0.175***	0.135***	0.276***	0.203***	0.084	0.130	0.141***	0.106***	0.228***	0.161***
	(3.91)	(2.95)	(4.70)	(3.35)	(0.81)	(1.47)	(3.98)	(2.76)	(4.66)	(3.21)
Years of Education	0.016	0.009	-0.001	-0.013	0.029	0.062	0.012	0.006	-0.002	-0.011
	(0.91)	(0.49)	(-0.05)	(-0.40)	(0.62)	(1.20)	(0.89)	(0.38)	(-0.08)	(-0.44)
Age of Hh Head	-0.012**	-0.011*	-0.020***	-0.019***	-0.006	-0.008	-0.009**	-0.008*	-0.015***	-0.014***
	(-2.23)	(-1.88)	(-3.17)	(-2.59)	(-0.45)	(-0.59)	(-2.34)	(-1.89)	(-3.27)	(-2.67)
Agriculture Share	0.293	0.273	-0.051	-0.122	1.477**	1.297**	0.219	0.194	-0.063	-0.127
	(1.18)	(1.10)	(-0.15)	(-0.36)	(2.42)	(2.06)	(1.17)	(1.01)	(-0.27)	(-0.54)
Adult Members	0.040	0.043	0.077	0.089	0.076	0.020	0.030	0.034	0.065	0.073
	(0.63)	(0.65)	(1.28)	(1.44)	(0.56)	(0.15)	(0.63)	(0.67)	(1.38)	(1.44)
Disabled Members	0.050	0.031	0.019	-0.013	0.812	0.969	0.032	0.015	-0.009	-0.035
	(0.38)	(0.22)	(0.13)	(-0.08)	(1.26)	(1.44)	(0.31)	(0.13)	(-0.08)	(-0.30)
Days Sick	0.000	0.000	0.001	0.000	0.011*	0.012*	0.000	0.000	0.001	0.000
	(-0.11)	(-0.33)	(0.36)	(0.24)	(1.84)	(1.88)	(-0.12)	(-0.31)	(0.40)	(0.27)
Sum of										
Log (Hh Wealth)	0.041	0.013	0.132**	0.050	0.266***	0.196***	0.098***	0.052	0.248***	0.162***
	(1.08)	(0.36)	(2.04)	(0.74)	(3.34)	(2.60)	(2.62)	(1.47)	(3.85)	(2.61)
Years of Education	-0.004	-0.008	-0.024	-0.033	-0.062	-0.081**	-0.019	-0.025	-0.037	-0.047*
	(-0.24)	(-0.45)	(-1.01)	(-1.40)	(-1.63)	(-2.00)	(-1.03)	(-1.41)	(-1.52)	(-1.88)
Age of Hh Head	0.004	0.005	-0.007	-0.004	-0.012	-0.009	0.000	0.002	-0.016***	-0.015**
	(0.96)	(1.32)	(-1.22)	(-0.69)	(-1.36)	(-1.04)	(0.09)	(0.52)	(-2.84)	(-2.38)
Agriculture Share	0.581**	0.479**	0.612	0.376	0.373	0.192	0.452**	0.326	-0.146	-0.394
	(2.49)	(2.04)	(1.57)	(0.95)	(0.77)	(0.42)	(1.97)	(1.42)	(-0.39)	(-1.03)
Adult Members	0.080	0.052	0.000	-0.078	0.201*	0.162	0.103**	0.063	-0.018	-0.094
	(1.63)	(1.11)	(0.00)	(-1.14)	(1.79)	(1.42)	(2.24)	(1.36)	(-0.26)	(-1.36)
Disabled Members	0.073	0.032	-0.031	-0.106	-0.676	-0.861	0.058	0.008	0.020	-0.032
	(0.92)	(0.39)	(-0.23)	(-0.67)	(-1.14)	(-1.37)	(0.65)	(0.09)	(0.14)	(-0.21)
Days Sick	0.000	0.001	0.001	0.002	-0.009*	-0.010*	0.000	0.001	0.001	0.002
	(0.43)	(0.60)	(1.18)	(1.29)	(-1.71)	(-1.64)	(0.23)	(0.61)	(0.76)	(1.08)
Villages	15	15	14	14	12	12	15	15	14	14
Households	445	445	415	415	359	359	445	445	415	415
Potential Links	12762	12762	11892	11892	5191	5191	12762	12762	11892	11892
Actual Links	292	292	90	90	69	69	430	430	120	120

Village fixed effects are calculated but not included in the table.
Village 71 was excluded from the "Unreciprocated Link, Lending Only" and "Any Link, Lending Only" regressions due to an absence of such links. Villages 27, 74, and 91 were excluded from the "Reciprocated Link" regressions due to an absence of such links.
*,**, and *** indicate significance at the 10%, 5%, and 1% levels. Dyadic t-values in parentheses.
"Absolute Value of Difference" is used instead of "Difference" in the "Reciprocated" regressions.