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Social Networks and Resilience: Evidence from Rural Guinea-Bissau

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Abstract

This study analyzes the effects of network centrality on vulnerability to shocks and examines the moderator role of centrality in the relationship between negative shocks and health expenditures. We use detailed network data collected in the village of Suzana, Guinea-Bissau. We elicited connections across different network dimensions, and constructed different centrality measures. Findings indicate that being a more central household reduces vulnerability. Furthermore, centrality significantly mitigates the negative effects of idiosyncratic shocks on health expenditures. Finally, results indicate that while health expenditure's stabilization is achieved through the chatting and financial support dimensions, vulnerability is better insured through the chatting dimension.

Keywords – Social Networks, Centrality, Shocks, Vulnerability, Health, Guinea-Bissau

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1. Introduction

In the world's poorest countries, mainly in Africa, life is plagued by risk. In a predominant rural scenario, incomes are low, irregular and unpredictable, as people have no formal jobs and mostly rely on subsistence agriculture to survive (Collins et al. 2009). With unforeseeable expenditure needs, no savings and without any means of formal financial support, the lives of the poor are exposed to a worrisome degree of vulnerability (Banerjee and Duflo 2007). Devastating consequences may further arise when facing unmitigated income, health and agricultural shocks (e.g., Deaton, 1997; Morduch, 1995, 1999)

Existing literature has studied insurance and risk sharing networks as a way of counteracting exposure to vulnerability, with particular focus in understanding how consumption remains stable while income fluctuates (e.g., Deaton, 1992; Gertler and Gruber, 2002; Ligon, 1998; Ligon et al., 2002; Townsend, 1994). However, to our knowledge, research is scarce on the relationship between social networks and specific vulnerability indicators, such as often lacking access to food, clean water, medical support and school supplies. Furthermore, little is known about the process that explains the effect of negative shock events on health expenditures. Specifically, no studies have yet been conducted focusing on analyzing the moderator role of social networks in this relationship.

Therefore, this study intends to contribute to address this gap by examining the direct effect of social networks on specific vulnerability to shocks' measures and analyze to what extend can social networks act as a mitigation mechanism against the effect of negative shocks on health expenditures.

Using detailed census and network data collected in the rural village of Suzana, Guinea-Bissau, with the application of a network elicitation mechanism, we were able to construct a complete network map comprehending all the households' social links in the village. Additionally, we elicited connections across different network dimensions (general network, chatting network,

financial support network), allowing us to examine the role each dimension plays on protection against shock events. Moreover, for each network dimension, we generated four different measures to capture each household's network centrality on different spectrums (in-degree of centrality, out-degree of centrality, betweenness centrality, closeness centrality).

After this introductory section, a review of the literature is presented in section 2. Section 3 refers to the context of this study. Section 4 presents an in-depth description of the data. Section 5 and 6 describes the estimation strategy and presents results. We finally conclude in section 7.

2. Literature Review

There is academic interest in studying networks as conduits for financial flows and of how social ties can be used to transfer money in a developing world context. The literature on informal insurance and risk sharing networks is vast, going from the study of how network formation takes place to its effects on the lives of the poorest. In this study, we will focus on the latter. For further reading on network formation, see Barr et al. (2015), Comola and Mendola (2015), Comola and Prina (2014), Fafchamps and Quinn (2012), Fafchamps and Gubert (2007), and De Weerdt (2004).

Evidence is clear on the individuals' needs for social networks in developing countries. Research indicates that a high share of households living under a dollar a day have access to some form of loan and a large proportion of monetary flows are transactions within social networks (Banerjee and Duflo, 2007; Collins et al., 2009).

Townsend (1994) was one of the first to provide evidence that individuals living in developing countries bear each other with informal insurance. Using data from rural India, Townsend does not find evidence of full insurance, as a small share of idiosyncratic income shocks are passed on to consumption, and implicitly assumes that sharing takes place at the village level. Otherwise, Udry (1994) investigated how friends and family use borrowing and lending

networks to insure one another rather than in the village as a whole. Taking this work a step further, Fafchamps and Lund (2003) look at gifts and transfers (in addiction to loans) and take into account potential partners instead of actual partners only. They found households receive help mainly from networks of friends and relatives. Dercon and De Weerdt (2006), instead of looking at lending, gifts and transfers separately, test whether all strategies together smooth consumption. At the village level, only food consumption is fully insured against health shocks, whereas nonfood consumption is only partially insured via smaller networks.

The literature proceeds into studying which networks are most useful in smoothing consumption and which are most useful in helping investments to happen. Kinnan and Townsend (2012) found that financial support networks, containing loans and transfers, are more useful for consumption smoothing, and kin networks are more useful for large investments. In line with this study, Angelucci et al. (2014), looking at the randomized Progresa conditional cash transfer in Mexico, found that this program was pooled within kin networks, enabling members to better smooth consumption and make higher return investments. The larger and more closely linked the networks are, the better is the achieving of consumption smoothing, in contrast with larger and less closely linked networks. The responses in investment are similar for both networks.

Further evidence suggests that not just who is linked to whom matters for risk sharing, but that other structural social network dimensions (e.g., type of relationship), are also of great importance (Ambrus et al., 2014b; Angelucci et al., 2014). Karlan et al. (2009), pioneers in studying the social network architectures, analyzed the distinction between the underlying network and the transfers flowing through that network, also, being one of the first to consider indirect links. They found that direct and indirect paths are equally contributing to risk-sharing.

Past literature focused on studying the specific relationship between consumption smoothing and insurance networks mostly over the functional dimension of social support (instrumental

support through transfers, loans and gifs). Only more recent literature on economics began to incorporate different dimensions of the network composition (structural dimension) into the analyses (Ambrus et al., 2014b; Angelucci et al., 2014; Karlan et al., 2009). On the other hand, to our knowledge, there is a dearth of research using specific vulnerability indicators, particularly on the relation between different measures of network centrality and lacking access to food, clean water, medical support and school supplies. Furthermore, little is known about the moderator role played by social networks in the relationship between the effect of negative shock events and health expenditures, focusing more in the role of centrality within a network and not restricting the analysis to transfers, loans or gifts.

The main goal of our study aims to address this gap in the literature and to complement the previous literature with the use of detailed and complete network data, comprehending different network specific variations, allowing a closer look. Not only we test the impact of support through networks in innovative outcomes, such as different measures of vulnerability to shocks and health expenditures, as we further add to the analysis the use of different network dimensions combined with a wide set of centrality measures, which could better help explaining the mechanisms behind risk-sharing networks in rural Africa. In specific, with this study, we aimed to: 1) explore the direct relationship between centrality and the specific vulnerability measures described above; and 2) examine the moderator effect of centrality across different social network dimensions, analyzing to what extend can social networks act as a mitigation mechanism of the negative shock effects on health expenditures.

3. Context

Guinea-Bissau, located in West Africa, is one of the poorest countries in the world, with a GDP per capita of $1596 PPP and 67 percent of its population living on less than $1.90 per day. It has a population of approximately 1.9 million, the majority of which (around 60 percent) live

in rural areas and mainly rely on subsistence agriculture. The life expectancy at birth is 55 years old for men and 59 years old for women (World Bank, 2018).

The setting for this study was the village of Suzana, in the northwest region of Guinea-Bissau - Region of Cacheu (Figure 1a in appendix). Suzana is a rural village, located in a very remote place, with 333 households spread across 8 neighborhoods. Most of the households in Suzana are from the Felupe ethnic group (around 90 percent), and the vast majority of individuals in the village work as subsistence farmers (around 80 percent).

To fully comprehend the context of this study, it is of most importance to note that the rural population of Guinea-Bissau, and of Suzana in specific, is exposed to many uninsured risks. People have no formal jobs, incomes are very low, irregular and unpredictable by nature, as crops are seasonal and heavily depend on climatic conditions. There is no access to credit or any form of insurance due to the lack of formal institutions and instruments, and savings are barely enough to cope with the consumption level and expenditure needs that may arise until the upcoming crop season (UNDP, 2019). With unpredictable income streams, unforeseeable expenditure needs and no financial support, Suzana's population is very vulnerable to any negative shock that may occur.

4. Measurement and Data

The data used on this study was collected within the scope of the ongoing project "Belief Systems and Health Behaviors in Guinea Bissau" conducted by NOVAFRICA Research Center, in partnership with the international NGO VIDA.

The data was collected in a single round, conducted in the village of Suzana, and included both a household census and a network survey, done separately. The household census contained questions relative to demographic and socio-economic characteristics of the household, comprising detailed information on the household composition, one section dedicated to

consumption, one to shocks and risk and other to household asset ownership. The network survey was related to the individuals responsible for the households and collected detailed and complete data on these individuals' network links. For both questionnaires, the respondent was the female head of the household, except in cases where this was not applicable.

Both the household census and the network survey took place between August and September of 2019 respectively. Although the village has 333 households, our sample contains 331 participants, given that two households have refused to complete the interviews. However, these two households were taken into account when constructing the social network centrality measures, this is, they count as a connection for the households who mentioned them. All the data was collected by a group of 9 trained enumerators who spoke the local language and had previous experience with this type of fieldwork.

4.1 Network variables

With the network survey we collected specific data on each household's social network. This data allowed us to construct complete network maps comprehending all the social links in the village of Suzana, along different social network dimensions, making possible to further investigate protection mechanisms against shock events happening within the village.

Each respondent was asked about all the connections with other residents of Suzana across three dimensions: i) chatting network, which is defined as individuals with whom the respondent frequently chats with (at least once a week); ii) financial support network, which includes individuals the respondent could ask for money in times of need; and iii) effective financial support network, which contains, from those mentioned in the financial support dimension, the individuals that the respondent actually asked for money. In this last dimension, to capture the effective link, we phrased the question in a way such that instead of eliciting the potential link - who *would* you go to? - we rather asked - who *did* you go to? -. This set of three network

questions was asked repeatedly in the same order for each of the eight neighborhoods of Suzana, meaning that each respondent answered this same set of three network questions eight times. To smooth fatigue bias, we randomly varied the order of the neighborhoods presented to the respondent. On top of these three dimensions, we further added to our analysis a fourth dimension: iv) general network, defined as the aggregate links of the chatting and the financial support network combined, this is, having a network link in any of the dimensions.

In order to collect the network links, we followed a two-step procedure. First, we asked each respondent to name all the individuals with whom they had a link with, according to each different network dimension. With the use of an open question method, we did not restrict the number of individuals each respondent could list (be linked with). The problem with this method is that it may tend to capture only the individuals that are closer to the respondent (strong links), as these are probably fresher in the respondent's memory, in comparison to the ones the respondent less frequently interacts with (weak links), which are probably easier to forget (Maertens and Barrett, 2013; Brewer, 2000; Santos and Barrett, 2011).

To counteract this potential limitation, as a second step, we used a village photo album with a picture of each household representative, collected in previous studies (for further details, see Caeiro, 2019) and updated during the current household census, to ascertain whether each respondent had any other link that was not mentioned previously, providing an easy and intuitive way of identifying weak links (see Figure 2a in appendix). In our study, we do not distinguish between strong links and weak links but by following this procedure we were able to collect much more complete and accurate data on each individual's links.

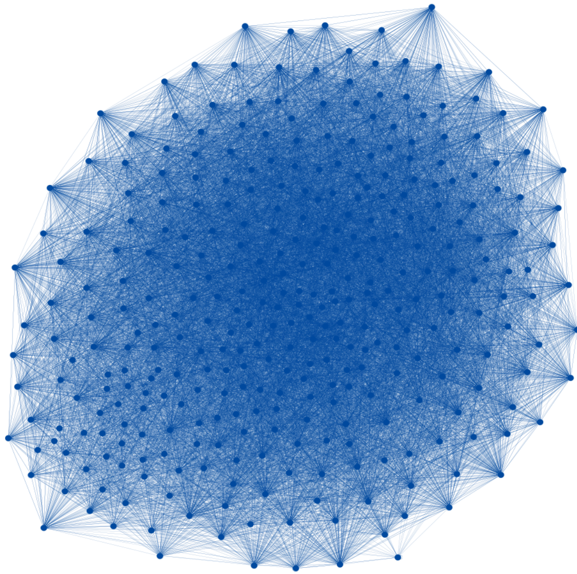

Figure 1- Visual representation of the chatting links among the 333 households in the village. Each node represents a household. The lines between nodes indicate the existence of a link

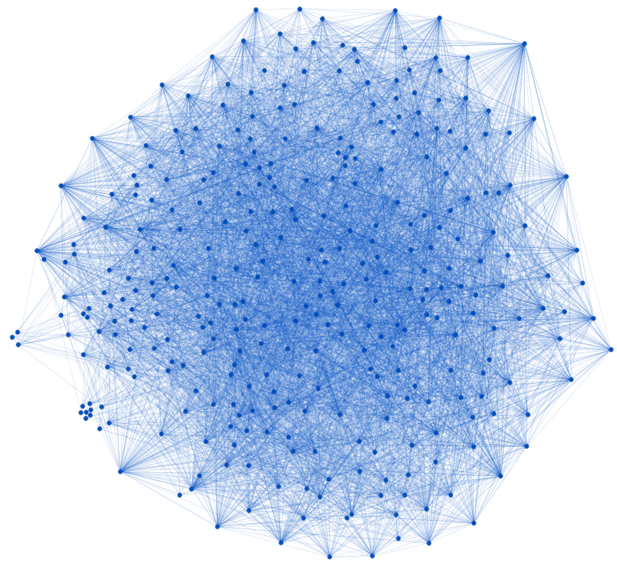

Figure 2- Visual representation of the financial support links among the 333 households in the village. Each node represents a household. The lines between nodes indicate the existence of a link.

Finally, taking advantage of the data, we computed different centrality measures which were used in our analysis. Using the procedures described by (Grund 2015) we constructed measures of centrality in terms of in-degree, out-degree, betweenness and closeness centrality for each of the network dimensions. Degree centrality is the most straightforward way to measure centrality and it simply captures how connected a household is to others by looking at the number of ties a household has. Where in-degree tells us the number of other households which have mentioned our own household (in), and out-degree describes the number of other households that each own household has mentioned (out). Betweenness centrality captures how important a node (household) is in connecting other nodes among each other (Freeman, 1977; Brandes, 2008), and it is defined as the number of shortest paths between all other households that go through this household. Closeness centrality measures how close a household is to all the other households in the village, this is, households with high closeness centrality can reach all the other households taking only a few steps, whereas households with low closeness centrality are

far from all the other households. Remember that each measure assumes different values for the same household according to the network dimension that is being considered. Degree of centrality refers to the actual number of connections and betweenness and closeness centrality measures were standardized, ranging between zero and one.

4.2 Shock variables

In this section, we will describe more into detail the section of the household census dedicated to shocks and risk. We intend to assess what is the impact of negative shock events on the lives of Suzana's population. For this, we collected data not only on idiosyncratic shocks but also on shocks that could affect the whole population at once. The effects of either of these types of shocks is tested in our study.

During the household census we asked each respondent whether if in the past twelve months they have suffered from a series of shocks. The answer would be yes or no. Each shock was presented one by one in the same order to every household. The shocks in question were: i) if someone close to the family passed away; ii) if someone from the own household passed away; iii) if someone from the own household lost his/her job; iv) if someone from the own household had any health problem which has prevented this person from work; v) if there was the occurrence of any disaster which has caused the household to lose any asset of great value (ex: robbery, fire); vi) if the household had a significant agricultural crop lost due to droughts; vii) if the household had a significant agricultural crop lost due to floods; and viii) if the household had a significant agricultural crop lost due to other reasons.

Further on, using these variables, aggregated measures of shocks were generated according to each shock category, giving us the number of shocks suffered by each household on each category. For the first shock category, we combined the shocks related to the loss of a close person, this is, i) and ii) above. This variable takes the values of 0, 1 or 2, corresponding to the

number of shocks suffered by each household. For the second shock category, we combined the shocks related to job loss, this is, iii) and iv) above. This variable assumes the values of 0, 1 or 2, corresponding to the number of shocks suffered. For the third shock category, we combined the shocks related to agricultural crop loss, this is, vi), vii) and viii) above. This variable takes the values of 0, 1, 2 or 3, once again, corresponding to the number of shocks suffered. We left the shock v) as it was, since it did not fit into any other shock category.

In sum, we have eight individual shock variables, which are binary and assume the value 1 if the shock occurred and 0 otherwise, and three aggregated shock measures, which are categorical variables and assume values for the number of shocks suffered by each household on each category.

4.3 Outcome variables

The analysis focuses in two main outcome variables of interest, which are comprehended in the consumption section of the household census. We first aim to study the impact of centrality on vulnerability to shocks, and second, the effect of shocks in interaction with social network centrality measures on the total health expenditures of the households of Suzana, this is, the moderator role of network centrality in the relationship between shocks and health expenditures.

In the section dedicated to consumption we asked each household how many times, if any, in the past twelve months, have they haver gone without: i) enough food to eat; ii) enough water for domestic use; iii) medicines or health care; and iv) money for the education expenses of their children, in this case, answered only by those who have children. Vulnerability is measured using a categorical indicator ranging from 1 to 4, where 1 denotes for never having suffered lack of access and 4 for having suffered many times (at least five times). Number 2 and 3 are intermediate values and stand for “just once” and “sometimes (from two to four

times)", respectively. Estimates were computed for each of the four individual vulnerability measures.

Our second outcome of interest is the total household expenditures on health. The household census collected data on the amount of money each household spent, in the past twelve months, on multiple health expenditures, such as on buying medicines, medical appointments, medical exams, traditional healer and a few other forms of expenses. The total value of expenditures on health was then obtained through the sum of each component. For estimation purposes, in our regression we use the squared root function of the total household expenditures on health. The monetary currency is the CFA franc, used in eight West African countries.

5. Estimation Strategy

In this study, we are interested in two main outcome variables. For the estimation of these parameters, we employ data at the household level. In the first specification, we are particularly interested in assessing what is the direct impact of social network centrality on vulnerability to shocks outcomes. As shocks are inherent to our vulnerability measures, we decided to test the effect of centrality directly in this case, following the specification:

$$Y_i = \alpha + \beta C_i + \gamma Z_i + \theta X_i + \varepsilon_i, \quad \textbf{(1)}$$

where Y_i represents the vulnerability to shocks for household i, which assumes to be each of our four vulnerability measures. C_i stands for centrality of household i and assumes to be one of the four centrality measures in our study (in-degree, out-degree, betweenness and closeness). Z_i is controlling for geographical characteristics of each neighborhood of Suzana. X_i is a vector of household characteristics, such as age of the respondent, years of education, number of

household members, an occupation dummy for farmer, an ethnicity dummy for Felupe, and household assets.

Next we have our second specification, in which the outcome of interest is the household total expenditures on health. We are particularly interested in estimating not only the direct impact of shocks but mostly the impact of shocks when interacted with network centrality measures, as we want to analyze whether centrality plays a mitigating role in the presence of negative shocks. Applying geographical and household-level controls we get the following specification:

$$Y_i = \alpha + \mu S_i + \beta C_i + \delta(S_i * C_i) + \gamma Z_i + \theta X_i + \varepsilon_i, \quad \textbf{(2)}$$

where Y_i represents the outcome variable of interest for household i, this is, the squared root of the total household expenditures on health. S_i describes how many different shocks have the household suffered in the past twelve months, according to each of the shock categories. C_i stands for centrality of household i and assumes to be one of the four centrality measures in our study (in-degree, out-degree, betweenness and closeness). $(S_i * C_i)$ is the interaction term between the shock and the centrality measure and it tells how much is the shock affecting our outcome of interest when we take into account the household's centrality, this is, if a household with more (less) centrality will be more or less affect by the shock in comparison to a household with less (more) centrality. Z_i is controlling for geographical characteristics of each neighborhood of Suzana. X_i is the same vector of household characteristics described in specification (1).

In specifications (1) and (2), we first controlled for the number of sick persons in the household, but as this variable was highly correlated with the number of household members and did not present any change to our estimates, we decided to control for number of household members

instead. All coefficients are estimated under the OLS framework. We estimate robust standard errors in all regressions.

6. Results

Econometric results are divided into four parts. First, we present descriptive statistics for the variables in our models. Second, we present the analysis of the effect of household centrality on vulnerability to shocks. We then move on to the analysis of the direct effect of negative shocks on total household health expenditures and on the moderator role played by network centrality in this relationship. Finally, we present robustness tests.

In our main tables, we present results for our broader network dimension, which comprises both the chatting and financial support dimensions into one unique dimension (general network). The robustness section will contain further discussion of the results for the chatting and financial support network single dimensions. We always present estimates for four different centrality measures (in-degree of centrality, out-degree of centrality, betweenness centrality and closeness centrality), as each measure captures a different form of centrality and impacts our outcomes differently. All the results covered in this section follow the specifications described in the previous sections, applying geographical and household-level controls - (1) and (2). For different control specifications, see table 1a, 2a and 3a in appendix.

6.1 Descriptive Statistics

In this section we present descriptive statistics for the sample in our study, which comprises 331 respondents. Summary statistics for individual household characteristics, shocks and centrality measures according to each network dimension are reported in table 1. Table 2 describes the network dimensions.

Table 1: Descriptive statistics - individual household characteristics, shocks, centrality measures.

		mean
basic demographics		
	age	51.789 (14.338)
	female	0.864 (0.343)
	years of education	1.991 (3.373)
	household number	4.967 (3.047)
ethnicity		
	felupe	0.903 (0.296)
occupation		
	farmer	0.752 (0.432)
shock category		
	loss of someone close	1.039 (0.680)
	agricultural shock	1.604 (0.819)
network dimension	***centrality***	
general network	**in-degree**	58.843 (38.523)
	out-degree	58.976 (27.866)
	betweenness	0.003 (0.002)
	closeness	0.587 (0.043)
chatting network	**in-degree**	53.930 (35.590)
	out-degree	54.057 (25.924)
	betweenness	0.003 (0.003)
	closeness	0.580 (0.041)
financial support network	**in-degree**	20.6858 (18.151)
	out-degree	20.710 (14.366)
	betweenness	0.004 (0.005)
	closeness	0.494 (0.048)

Note: Table shows averages and corresponding standard errors in parenthesis for individual household characteristics, shock category, and centrality measures.

Looking at the basic demographics in table 1, we see that respondents have on average 51 years old and have completed approximately 2 years of education, on average. The average number of people living in the same household is very close to 5. Most of the respondents are women

(86 percent) and belong to the Felupe ethnic group (90 percent). In respect to the main occupation, 75 percent of the respondents are farmers, and the second most common occupation is housekeeping. Each household suffered on average, in the past twelve months, from 1 shock related to the loss of someone close and 1.6 shocks related to agricultural losses. Furthermore, we observe that each household is connected, on average, with approximately 59 other households for the general network dimension, 54 for the chatting network dimension and 20 for the financial support dimension. The average values for betweenness centrality and closeness centrality for each network dimension are also shown in table 1.

Table 2: Descriptive statistics - network dimensions.

	total
network dimension:	
general network	19514
chatting network	17890
financial support network	6851

Note: Table shows the total number of links contained on each network.

Table 2 shows how many links each network dimension has. The general network comprehends 19514 links, the chatting network has 17890 links and the financial support network is made of 6851 links.

6.2 Vulnerability

We start by examining the effects of being a more or less central household on vulnerability to shocks. Table 4 displays the estimates of the effects on three different types of vulnerability: i) no access to food: ii) no access to clean water; and iii) no access to health care or medicines.

Because results were not significant for lack of school supplies and the sample size for this particular measure was different (since not all of the respondents in our study have children), we have decided not to include these for better reading and comprehension of the table.

Table 3: The effects of centrality on vulnerability to shocks - general network dimension

dependent variable ------>		Vulnerability			
centrality measure ------>		in degree	out degree	betweenness	closeness
		(1)	(2)	(3)	(4)
Types of vulnerability:					
No access to food	centrality	-0.004**	-0.004*	-37.195	-3.467**
		(0.002)	(0.002)	(23.790)	(1.536)
	constant	1.741***	1.802***	1.707***	3.572***
		(0.516)	(0.518)	(0.516)	(0.985)
	r-squared adjusted	0.148	0.146	0.143	0.150
No access to clean water	centrality	-0.002*	-0.002	-11.723	-2.030*
		(0.001)	(0.001)	(16.474)	(1.097)
	constant	1.822***	1.838***	1.789***	2.897***
		(0.373)	(0.375)	(0.374)	(0.701)
	r-squared adjusted	0.144	0.141	0.139	0.146
No access to health care or medicines	centrality	-0.001	-0.005**	-26.401	-2.624
		(0.002)	(0.002)	(30.117)	(1.731)
	constant	1.616***	1.789***	1.629***	3.043***
		(0.588)	(0.594)	(0.584)	(1.118)
	r-squared adjusted	0.078	0.090	0.080	0.084
number of observations		331	331	331	331
controls		yes	yes	yes	yes

Note: All regressions are OLS. The unit of observation is the household. The dependent variable is a vulnerability index, measured using a categorical indicator ranging from 1 to 4, where 1 denotes for never having suffered lack of access and 4 having suffered many times (at least five times). Controls are accounting for geographical characteristics and household individual demographic characteristics. Demographic characteristics include gender, years of education, number of people who are part of the household, ethnic group, occupation and a measure of wealth based on household assets. Robust standard errors reported in parenthesis. * significant at 10%; ** significant at 5%; *** significant at 1%.

For vulnerability related to accessing food, either in-degree centrality and closeness centrality have negative and statistically significant coefficients at the 5% level of significance, and out-degree of centrality has a negative and less strong but still statistically significant coefficient at the 10% level. The evidence is suggesting that being a more central household in the network of Suzana, at different levels of centrality, such as being linked with more households (degree) and being closer to the other members of the village (closeness), plays an important role in reducing the lack of access to food. Secondly, concerning lack of access to clean water, we find

less strong results, with negative and statistically significant coefficients for in-degree centrality and closeness centrality, at the 10% level. Finally, looking at absence of health care, out-degree centrality has a strong effect, with a negative and statistically significant coefficient at the 5% level, meaning that, on average, having more connections reduces vulnerability.

Results vary according to the centrality measure and are different across the three different types of vulnerabilities presented in table 4. This leads to interpret that each state of vulnerability is reduced through different types of centrality. For instance, while absence of health care decreases only through the proximity with other households, lack of food is decreased also by having more links across the village. Yet, we can record that the sign of the coefficient is always negative, suggesting that for all the statistically significant coefficients, centrality is reducing vulnerability to shocks.

6.3 Health Expenditures

We now turn to our analysis of the effect of negative shocks on health expenditures. It is of our main interest to estimate the effect of shocks when interacted with centrality measures (moderator). This allows us to study whether network centrality is functioning as a mechanism of alleviation of the effect caused by shocks.

Table 5 displays results for the first shock category - loss of a close person - and Table 6 displays results for the third shock category - agricultural crop loss. In both tables, the outcome variable is the squared root of the household total expenditures on health.

Table 4: Coping with the loss of someone close - general network dimension

dependent variable ------>	Total Household Expenditures on Health			
centrality measure ------>	in degree	out degree	betweenness	closeness
	(1)	(2)	(3)	(4)
centrality * shock	0.503**	1.074***	13 140.142***	690.856***
	(0.221)	(0.301)	(3 387.025)	(180.247)
shock	-24.077*	-56.932***	-27.730**	-397.952***
	(14.161)	(19.776)	(12.323)	(105.194)
centrality	-0.769**	-1.229***	-15 661.607***	-832.991***
	(0.302)	(0.406)	(4 025.422)	(245.413)
constant	107.897*	134.616**	103.424*	552.295***
	(57.408)	(57.607)	(55.902)	(147.719)
r-squared adjusted	0.261	0.276	0.279	0.275
number of observations	331	331	331	331
controls	yes	yes	yes	yes

Note: All regressions are OLS. The unit of observation is the household. The dependent variable is the squared root of the total household expenditures on health, in CFA francs. The shock category being considered is the "loss of someone close". Controls are accounting for geographical characteristics and household individual demographic characteristcs. Demographic characteristics include gender, years of education, number of people who are part of the household, ethnic group, occupation and a measure of wealth based on household assets. Robust standard errors reported in parenthesis. * significant at 10%; ** significant at 5%; *** significant at 1%.

The results presented in table 5, indicate overall strong evidence suggesting that the direct effect of the shock and the effect of the shock when interacted with centrality are significantly impacting the total household expenditures on health. For all the regressions, the direct effect of the shock is negative and statistically significant (at 1% level for (2) and (4), 5% level for (3), and 10% level for (1)). This evidence suggests that having suffered from more “loss of a close person” events will, on average, significantly decrease the total household expenditures on health. As for the effect of the shock when interacted with the different measures of centrality, we observe that all the coefficients have a positive sign and are statistically significant at the conventional levels of significance. For out-degree of centrality (2), betweenness centrality (3) and closeness centrality (4) coefficients are significant at a 1% level of significance and for in-degree of centrality the coefficient is significant at a 5% level. These results strongly suggest that although shocks are negatively impacting the household expenditures on health, having a strong network (in multiple forms) can significantly decrease

this negative effect. This is, evidence is suggesting that having more people as part of our social network or more people closer to us, strongly contribute to survive to negative shock events of this category, in this particular case, coping with health necessities.

Table 5: Coping with agricultural crop loss - general network dimension

dependent variable ------>	Total Household Expenditures on Health			
centrality measure ------>	in degree	out degree	betweenness	closeness
	(1)	(2)	(3)	(4)
centrality * shock	0.424*	0.207	6 962.302**	276.703
	(0.235)	(0.270)	(2 873.206)	(190.684)
shock	-11.913	-3.691	-6.190	-150.852
	(14.774)	(16.922)	(10.006)	(110.776)
centrality	-1.023**	-0.499	-15 651.440***	-642.254*
	(0.426)	(0.464)	(4 838.914)	(332.328)
constant	106.296*	106.729*	112.799*	439.706**
	(55.194)	(60.660)	(57.550)	(190.600)
r-squared adjusted	0.262	0.252	0.266	0.257
number of observations	331	331	331	331
controls	yes	yes	yes	yes

Note: All regressions are OLS. The unit of observation is the household. The dependent variable is the squared root of the total household expenditures on health, in CFA francs. The shock category being considered is the "agricultural crop loss". Controls are accounting for geographical characteristics and household individual demographic characteristcs. Demographic characteristics include gender, years of education, number of people who are part of the household, ethnic group, occupation and a measure of wealth based on household assets. Robust standard errors reported in parenthesis. * significant at 10%; ** significant at 5%; *** significant at 1%.

Table 6 contains the results concerning the agricultural shock category. We observe that, in this case, the direct effect of the shock has no significance across all the different regressions, although the coefficients keep the negative sign. Yet, we still have particular interest in analyzing the effect of the shock when interacted with network centrality. Here, coefficients are positive and statistically significant for in-degree and betweenness centrality, at 10% and 5% levels of significance respectively, showing that despite the non-significant direct effect, centrality still takes an important role in helping to overcome agricultural shocks when considering these centrality measures, although the estimates are much weaker in this case.

A key result from our study derives from the comparison between the estimates comprehending the loss of someone close, and the estimates comprehending the agricultural crop loss. While the first is defined as an idiosyncratic shock, affecting each household individually, the second is considered an aggregate shock, affecting the village of Suzana as a single unit. When looking at the estimates reported in table 4 and table 5, the evidence is clear on the importance of network centrality when dealing with idiosyncratic shocks, but not so clear when dealing with aggregate shocks. Although the dependent variables used in the present study differ from most of the outcomes found in the literature, the evidence on this matter is similar to the evidence obtained on past studies (e.g., Deaton,1997; Townsend, 1994; Udry, 1990).

6.4 Robustness

Our main results on the effect of shocks on the total household expenditures on health are robust to the use of each individual network dimension, this is, the use of the chatting and financial support network dimensions separately. We find only few minor changes as we move across different centrality measures, but overall, the estimates remain stable for either of the shock effects.

When considering the chatting network dimension only, results for the estimates of the effects of both types of shocks studied remain exactly the same (see table 4a and 5a in appendix).

When considering the financial support network dimension, we notice a few changes in results: For the first shock category (*loss of someone close*), the estimates using in-degree centrality lose significance, suggesting that the number of times someone is mentioned by others is not contributing for a better outcome of expenditures. Out-degree of centrality, betweenness centrality and closeness centrality, when in interaction with the shock effect, still present significant results at the conventional levels of significance, although in this case, there is no

direct effect of the shock. For the agricultural shocks, results are similar to the ones found using the general network dimension (see table 6a and 7a in appendix).

When we apply the same robustness test for the effect of network centrality on the vulnerability to shocks outcomes, we encounter different results, mostly when considering the financial support network dimension alone.

For the chatting dimension, results are supportive of our main findings (general network) and even increase significance levels of our coefficients for some of the centrality measures. In the first vulnerability outcome - *no access to food* -, the coefficient for out-degree of centrality goes from being statistically significant at a 5% percent level of significance to being significant at the 1% level, and the coefficient for betweenness centrality goes from not being significant to a coefficient statistically significant at a 5 % level of significance. For the *no access to clean water* and *no access to health treatment* outcomes, results are consistent with the ones found using the general network dimension (see table 8a in appendix). We still find no significant results for the school supplies vulnerability outcome.

When observing the financial support network dimension alone, for the same outcomes and using the same set of centrality measures, we find inconsistent results. In this case we do not find proof that centrality measures significantly impact vulnerability to shocks (see table 9a in appendix). Only in-degree of centrality appears to have a significant impact on reducing food vulnerability, with a negative and statistically significant coefficient at the 5% level of significance. This evidence is suggesting that the support each household gets from the people with whom the respondent usually talks with, seems to be more important than the support it gets from the potential financial support network, when it comes to vulnerability to shocks.

7. Conclusion

This study analyzes the role of social networks as a mechanism to overcome negative shock events, in rural Guinea-Bissau. We look through the direct effect of centrality on specific vulnerability to shock's measures and through the moderator role of centrality on the effect of shocks on household health expenditures. We collected detailed census and network data, allowing to construct a complete network map comprehending all the network links in the village of Suzana. This made possible to disentangle the effects of social networks across different network dimensions (general, chatting and financial support) and four different network centrality measures (in-degree, out-degree, betweenness and closeness).

Using the general network dimension, we find overall strong results indicating that having a strong social network can help reducing vulnerability to shocks. Social networks impact different vulnerability outcomes in different ways. While *lack of access to food* appears to be reduced mostly by how close a household is to the other households (closeness centrality), *lack of access to health care* seems to only be significantly reduced by the size of the household's network (out-degree of centrality). This suggests there are different mechanisms behind social support that are positively impacting vulnerability to shocks, this is, reducing vulnerability. The results obtained show the importance of considering different measures of vulnerability in specific, instead of looking only at general consumption smoothing, as each specific vulnerability measure is impacted in a different way, also underlying the need for the application of different centrality measures.

We then used each specific network dimension separately and found that the social support is mostly coming from the people with whom the respondent of the household usually talks with (chatting network) and not from the potential financial support network, which may indicate that people in the village of Suzana are less vulnerable to *lack of access to food*, *water* and *health care* not only due to monetary transfers, loans or gifts (financial support), but due to

other forms of support happening within the chatting network, which our study acknowledges not to be capable of investigating.

After analyzing the impact of centrality on vulnerability to shocks, we went on investigating the role of centrality in moderating the effect of negative shocks on the health expenditures of the households of Suzana. The shocks considered in this analysis were *the loss of someone close* and *agricultural crop losses*. We intend to study how health expenditures fluctuate in function of the number of negative shocks suffered and how would this effect change when considering the centrality of each household. We find that households who suffer from more shocks of the first category (*the loss of someone close*) end up significantly reducing their expenditures on health. This is not due to a reduction of medical needs, as we control for the health conditions of the household, instead, it is associated with a reduction of income sources in the household. When considering the moderator role of household centrality, we find evidence suggesting that having more connections and being closer to the other households, highly smooths the negative effect of shocks. Meaning that a more central household will react better to the shock than a less central household, on average. We find less evidence of the importance of centrality when considering agricultural shocks. The evidence is clear on the importance of network centrality when dealing with idiosyncratic shocks, but not so clear when dealing with aggregate shocks, in conformity with previous literature (e.g., Deaton,1997; Townsend, 1994; Udry, 1990).

These findings are robust to the use of each individual network dimension, this is, the use of the chatting and financial support network dimensions separately. We find only few minor changes as we move across different centrality measures, but overall, the estimates remain stable for either of the shock effects. This leads us to conclude that being more central is contributing for a better outcome in health expenditures, not only through the financial support network, but also through the chatting network. Once again, our study acknowledges not being

capable of investigating the means by which chatting networks contribute for the mitigation of negative shock effects.

Although results indicate that being more central within the chatting network highly impacts the outcomes analyzed in this study, a great limitation of this work is the lack of indicators capable of measuring the means by which this network dimension is contributing for the obtained outcomes. Future studies should address this limitation. Nevertheless, we consider that the results obtained in this study could contribute to improve the understanding of the role of social networks in a context of extreme poverty, namely: 1) on specific measures of vulnerability; 2) as moderator in the relationship between negative shock events and health expenditures; and, 3) across different network dimensions and using multiple centrality measures.

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Social Networks and Resilience: Evidence from Rural Guinea-Bissau

Appendix

Figure 1: Map of Guinea Bissau

Figure 2: Photo-Album (example)

Table 1a: The effects of centrality on vulnerability to shocks - general network dimension (no controls specification)

dependent variable ------>		Vulnerability							
centrality measure ------>		in degree		out degree		betweenness		closeness	
		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Types of vulnerability:									
No access to food	centrality	-0.004**	-0.004**	-0.004*	-0.004*	-55.236**	-37.195	-3.831***	-3.467**
		(0.002)	(-0.002)	(0.002)	(-0.002)	(23.910)	(-23.790)	(1.407)	(-1.536)
	constant	2.185***	1.741***	2.224***	1.802***	2.115***	1.707***	4.220***	3.572***
		(0.117)	(-0.516)	(0.153)	(-0.518)	(0.094)	(-0.516)	(0.835)	(-0.985)
	r-squared adjusted	0.012	0.148	0.008	0.146	0.011	0.143	0.018	0.150
No access to clean water	centrality	-0.003**	-0.002*	-0.003**	-0.002	-24.860	-11.723	-2.858***	-2.030*
		(0.001)	(-0.001)	(0.002)	(-0.001)	(18.852)	(-16.474)	(1.003)	(-1.097)
	constant	1.581***	1.822***	1.613***	1.838***	1.497***	1.789***	3.111***	2.897***
		(0.085)	(-0.373)	(0.108)	(-0.375)	(0.071)	(-0.374)	(0.603)	(-0.701)
	r-squared adjusted	0.011	0.144	0.008	0.141	0.003	0.139	0.021	0.146
No access to health care or medicines	centrality	-0.000	-0.001	-0.005**	-0.005**	-23.232	-26.401	-1.899	-2.624
		(0.002)	(-0.002)	(0.002)	(-0.002)	(26.127)	(-30.117)	(1.422)	(-1.731)
	constant	2.632***	1.616***	2.928***	1.789***	2.686***	1.629***	3.741***	3.043***
		(0.119)	(-0.588)	(0.152)	(-0.594)	(0.098)	(-0.584)	(0.840)	(-1.118)
	r-squared adjusted	-0.003	0.078	0.011	0.090	-0.001	0.080	0.002	0.084
number of observations		331	331	331	331	331	331	331	331
controls		no	yes	no	yes	no	yes	no	yes

Note: All regressions are OLS. The unit of observation is the household. The dependent variable is a vulnerability index, measured using a categorical indicator ranging from 1 to 4, where 1 denotes for never having suffered lack of access and 4 having suffered many times (at least five times). Controls are accounting for geographical characteristics and household individual demographic characteristics. Demographic characteristics include gender, years of education, number of people who are part of the household, ethnic group, occupation and a measure of wealth based on household assets. Robust standard errors reported in parenthesis. * significant at 10%; ** significant at 5%; *** significant at 1%.

Table 2a: Coping with the loss of someone close - general network dimension (no controls specification)

dependent variable ------>	Total Household Expenditures on Health							
centrality measure ------>	in degree		out degree		betweenness		closeness	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
centrality * shock	0.226	0.503**	0.776**	1.074***	6 806.790*	13 140.142***	406.337*	690.856***
	(0.265)	(0.221)	(0.374)	(0.301)	(3 839.612)	(3 387.025)	(243.836)	(180.247)
shock	-15.251	-24.077*	-45.777*	-56.932***	-17.993	-27.730**	-239.110*	-397.952***
	(17.617)	(14.161)	(25.504)	(19.776)	(14.439)	(12.323)	(144.113)	(105.194)
centrality	0.095	-0.769**	-1.044**	-1.229***	-1 705.105	-15 661.607***	-289.930	-832.991***
	(0.321)	(0.302)	(0.486)	(0.406)	(4 385.157)	(4 025.422)	(297.700)	(245.413)
constant	136.977***	107.897*	201.355***	134.616**	145.568***	103.424*	311.004*	552.295***
	(23.207)	(57.408)	(34.310)	(57.607)	(19.313)	(55.902)	(177.620)	(147.719)
r-squared adjusted	0.003	0.261	0.009	0.276	0.008	0.279	0.002	0.275
number of observations	331	331	331	331	331	331	331	331
controls	no	yes	no	yes	no	yes	no	yes

Note: All regressions are OLS. The unit of observation is the household. The dependent variable is the squared root of the total household expenditures on health, in CFA francs. The shock category being considered is the "loss of someone close". Controls are accounting for geographical characteristics and household individual demographic characteristics. Demographic characteristics include gender, years of education, number of people who are part of the household, ethnic group, occupation and a measure of wealth based on household assets. Robust standard errors reported in parenthesis. * significant at 10%; ** significant at 5%; *** significant at 1%.

Table 3a: Coping with agricultural crop loss - general network dimension (no controls specification)

dependent variable ------>	Total Household Expenditures on Health							
centrality measure ------>	in degree		out degree		betweenness		closeness	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
centrality * shock	0.412	0.424*	0.258	0.207	4 435.075	6 962.302**	335.901*	276.703
	(0.251)	(0.235)	(0.310)	(0.270)	(2 938.003)	(2 873.206)	(196.934)	(190.684)
shock	-21.793	-11.913	-11.745	-3.691	-10.744	-6.190	-193.387*	-150.852
	(14.806)	(14.774)	(18.639)	(16.922)	(10.585)	(10.006)	(113.881)	(110.776)
centrality	-0.343	-1.023**	-0.692	-0.499	-2 730.966	-15 651.440***	-434.275	-642.254*
	(0.436)	(0.426)	(0.583)	(0.464)	(5 337.859)	(4 838.914)	(361.920)	(332.328)
constant	153.730***	106.296*	174.940***	106.729*	144.863***	112.799*	386.383*	439.706**
	(24.005)	(55.194)	(34.322)	(60.660)	(18.530)	(57.550)	(207.317)	(190.600)
r-squared adjusted	0.009	0.262	-0.004	0.252	0.005	0.266	0.001	0.257
number of observations	331	331	331	331	331	331	331	331
neighbourhood controls	no	yes	no	yes	no	yes	no	yes

Note: All regressions are OLS. The unit of observation is the household. The dependent variable is the squared root of the total household expenditures on health. in CFA francs. The shock category being considered is the "agricultural crop loss". Controls are accounting for geographical characteristics and household individual demographic characteristics. Demographic characteristics include gender, years of education, number of people who are part of the household, ethnic group, occupation and a measure of wealth based on household assets. Robust standard errors reported in parenthesis. * significant at 10%; ** significant at 5%; *** significant at 1%.

Table 4a: Coping with the loss of someone close - chatting network dimension

dependent variable ------>	**Total Household Expenditures on Health**			
centrality measure ------>	**in degree**	**out degree**	**betweenness**	**closeness**
	(1)	**(2)**	**(3)**	**(4)**
centrality * shock	0.566**	1.218***	12 247.445***	775.997***
	(0.229)	(0.349)	(3 391.950)	(197.419)
shock	-24.847*	-58.395***	-26.564**	-441.255***
	(13.761)	(20.362)	(12.209)	(113.463)
centrality	-0.856***	-1.388***	-14 468.796***	-931.093***
	(0.314)	(0.470)	(3 881.489)	(268.860)
constant	109.483*	137.326**	106.579*	603.103***
	(57.104)	(57.982)	(56.323)	(158.159)
r-squared adjusted	0.262	0.277	0.277	0.277
number of observations	331	331	331	331
controls	yes	yes	yes	yes

Note: All regressions are OLS. The unit of observation is the household. The dependent variable is the squared root of the total household expenditures on health, in CFA francs. The shock category being considered is the "loss of someone close". Controls are accounting for geographical characteristics and household individual demographic characteristics. Demographic characteristics include gender, years of education, number of people who are part of the household, ethnic group, occupation and a measure of wealth based on household assets. Robust standard errors reported in parenthesis. * significant at 10%; ** significant at 5%; *** significant at 1%.

Table 5a: Coping with agricultural crop loss - chatting network dimension

dependent variable ------>	**Total Household Expenditures on Health**			
centrality measure ------>	**in degree**	**out degree**	**betweenness**	**closeness**
	(1)	**(2)**	**(3)**	**(4)**
centrality * shock	0.454*	0.173	5 748.993**	279.434
	(0.253)	(0.291)	(2 669.597)	(203.608)
shock	-11.478	-1.229	-4.155	-150.765
	(14.714)	(16.592)	(9.828)	(116.676)
centrality	-1.098**	-0.424	-13 326.469***	-654.808*
	(0.461)	(0.498)	(4 561.349)	(356.843)
constant	105.671*	101.539*	107.284*	444.180**
	(55.013)	(61.264)	(57.249)	(202.195)
r-squared adjusted	0.262	0.251	0.263	0.257
number of observations	331	331	331	331
controls	yes	yes	yes	yes

Note: All regressions are OLS. The unit of observation is the household. The dependent variable is the squared root of the total household expenditures on health. in CFA francs. The shock category being considered is the "agricultural crop loss". Controls are accounting for geographical characteristics and household individual demographic characteristics. Demographic characteristics include gender, years of education, number of people who are part of the household, ethnic group, occupation and a measure of wealth based on household assets. Robust standard errors reported in parenthesis. * significant at 10%; ** significant at 5%; *** significant at 1%.

Table 6a: Coping with the loss of someone close - financial support network dimension

dependent variable ------>	Total Household Expenditures on Health			
centrality measure ------>	in degree	out degree	betweenness	closeness
	(1)	(2)	(3)	(4)
centrality * shock	0.712	1.161**	4 320.279***	282.990*
	(0.600)	(0.528)	(1 410.654)	(151.293)
shock	-10.595	-20.660	-13.338	-135.782*
	(12.932)	(14.765)	(11.221)	(73.773)
centrality	-1.056	-1.517**	-4 276.413***	-567.728***
	(0.742)	(0.687)	(1 560.585)	(210.144)
constant	88.126	95.263*	80.231	333.348***
	(57.110)	(55.867)	(55.446)	(109.452)
r-squared adjusted	0.253	0.259	0.260	0.261
number of observations	331	331	331	331
controls	yes	yes	yes	yes

Note: All regressions are OLS. The unit of observation is the household. The dependent variable is the squared root of the total household expenditures on health. in CFA francs. The shock category being considered is the "loss of someone close". Controls are accounting for geographical characteristics and household individual demographic characteristics. Demographic characteristics include gender, years of education. number of people who are part of the household, ethnic group, occupation and a measure of wealth based on household assets. Robust standard errors reported in parenthesis. * significant at 10%; ** significant at 5%; *** significant at 1%.

Table 7a: Coping with agricultural crop loss - financial support network dimension

dependent variable ------>	Total Household Expenditures on Health			
centrality measure ------>	in degree	out degree	betweenness	closeness
	(1)	(2)	(3)	(4)
centrality * shock	1.150**	0.373	3 318.628*	108.533
	(0.500)	(0.622)	(1 826.568)	(152.570)
shock	-10.881	1.388	-3.265	-41.477
	(12.067)	(15.497)	(10.615)	(76.654)
centrality	-2.417***	-1.136	-6 439.412**	-437.432**
	(0.889)	(1.142)	(2 975.496)	(209.746)
constant	100.571*	90.016	92.368*	261.164**
	(54.574)	(55.898)	(55.917)	(101.331)
r-squared adjusted	0.263	0.253	0.256	0.261
number of observations	331	331	331	331
controls	yes	yes	yes	yes

Note: All regressions are OLS. The unit of observation is the household. The dependent variable is the squared root of the total household expenditures on health, in CFA francs. The shock category being considered is the "agricultural crop loss". Controls are accounting for geographical characteristics and household individual demographic characteristics. Demographic characteristics include gender, years of education, number of people who are part of the household, ethnic group, occupation and a measure of wealth based on household assets. Robust standard errors reported in parenthesis. * significant at 10%; ** significant at 5%; *** significant at 1%.

Table 8a: The effects of centrality on vulnerability to shocks - chatting network dimension

dependent variable ------>		Vulnerability			
centrality measure ------>		in degree	out degree	betweenness	closeness
		(1)	(2)	(3)	(4)
Types of vulnerability:					
No access to food	centrality	-0.004**	-0.005**	-38.079*	-4.007**
		(0.002)	(0.002)	(22.148)	(1.639)
	constant	1.745***	1.838***	1.710***	3.864***
		(0.517)	(0.517)	(0.515)	(1.032)
	r-squared adjusted	0.148	0.150	0.144	0.153
No access to clean water	centrality	-0.002	-0.002	-10.515	-2.110*
		(0.001)	(0.002)	(15.690)	(1.178)
	constant	1.821***	1.841***	1.788***	2.938***
		(0.373)	(0.375)	(0.374)	(0.737)
	r-squared adjusted	0.143	0.141	0.138	0.146
No access to health care or medicines	centrality	-0.001	-0.006**	-22.180	-3.152*
		(0.002)	(0.003)	(28.428)	(1.835)
	constant	1.615***	1.819***	1.623***	3.330***
		(0.589)	(0.594)	(0.585)	(1.167)
	r-squared adjusted	0.078	0.093	0.079	0.085
number of observations		331	331	331	331
controls		yes	yes	yes	yes

Note: All regressions are OLS. The unit of observation is the household. The dependent variable is a vulnerability index, measured using a categorical indicator ranging from 1 to 4, where 1 denotes for never having suffered lack of access and 4 having suffered many times (at least five times). Controls are accounting for geographical characteristics and household individual demographic characteristics. Demographic characteristics include gender, years of education, number of people who are part of the household, ethnic group, occupation and a measure of wealth based on household assets. Robust standard errors reported in parenthesis. * significant at 10%; ** significant at 5%; *** significant at 1%.

Table 9a: The effects of centrality on vulnerability to shocks - financial support network dimension

dependent variable ------>		Vulnerability			
centrality measure ------>		in degree	out degree	betweenness	closeness
		(1)	(2)	(3)	(4)
Types of vulnerability:					
No access to food	centrality	-0.008**	-0.003	-15.022	-1.733
		(0.004)	(0.005)	(11.491)	(1.613)
	constant	1.675***	1.667***	1.646***	2.349***
		(0.513)	(0.517)	(0.516)	(0.848)
	r-squared adjusted	0.147	0.139	0.141	0.142
No access to clean water	centrality	-0.004	-0.001	-1.413	-1.285
		(0.002)	(0.003)	(8.269)	(0.965)
	constant	1.784***	1.776***	1.770***	2.291***
		(0.372)	(0.375)	(0.373)	(0.529)
	r-squared adjusted	0.142	0.138	0.138	0.141
No access to health care or medicines	centrality	-0.000	0.000	2.069	-1.507
		(0.004)	(0.005)	(12.917)	(1.729)
	constant	1.587***	1.585***	1.587***	2.197**
		(0.587)	(0.587)	(0.587)	(0.899)
	r-squared adjusted	0.077	0.077	0.077	0.080
number of observations		331	331	331	331
controls		yes	yes	yes	yes

Note: All regressions are OLS. The unit of observation is the household. The dependent variable is a vulnerability index, measured using a categorical indicator ranging from 1 to 4, where 1 denotes for never having suffered lack of access and 4 having suffered many times (at least five times). Controls are accounting for geographical characteristics and household individual demographic characteristics. Demographic characteristics include gender, years of education, number of people who are part of the household, ethnic group, occupation and a measure of wealth based on household assets. Robust standard errors reported in parenthesis. * significant at 10%; ** significant at 5%; *** significant at 1%.