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Trust and Trustworthiness in the Aftermath of Natural Disasters: Experimental Evidence from the 2010 Chilean Earthquake

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ABSTRACT

Peoples' behavior in the aftermath of natural disasters may depend critically on various conditions. In this paper we postulate three conditions, likely to occur after massive natural disasters, that can adversely affect the trusting behavior of people within communities: rivalry for scarce relief and recovery recourses, increment of information asymmetries between agents (what we call *aftermath moral hazard*) that provides excuses to break pre-established-social contracts, and migration or social displacement of people. To investigate this issue a series of trust games were conducted in Chile to analyze whether the 2010 earthquake affected the trust and trustworthiness of villagers in rural areas. Experiments were conducted one year after the occurrence of the earthquake in a group of villages that were heavily affected by this disaster and in a group of villages that were not affected (villages that act as control group). Game outcomes and additional socioeconomic data collected with surveys are compared and analyzed by statistical tests and regressions. We find that trust levels (and most socioeconomic characteristics of participants) are not statistically different between groups. However, we find that trustworthiness levels of affected villages are lower than levels observed in control villages, supporting our argument that aftermath conditions can negatively affect trusting behavior. Results are important in assessing vulnerability and resilience to natural disasters, and therefore relevant for policy regarding aid and recovery of communities affected by these types of events.

JEL classification: A13, C93, D00, D03, Q54

1. Introduction

Without doubt a community will not be the same once a natural disaster hits it. Besides all the material damage and economic losses that a region can suffer, the difficult conditions of the aftermath of a natural disaster may affect the endowment of communities' social capital. In particular, attitudes, perceptions and behavior of people such as trust and trustworthiness can be affected.[1] Specially, we argue that three conditions provided by the aftermath of massive natural disasters may negatively affect trust and trustworthiness between people of a village/town: rivalry for scarce relief and recovery recourses, the excuse to break pre-established-social contracts induced by what we call *aftermath moral hazard*, and migration or social displacement of people within communities. Ideally policy and programs aimed to support affected communities should consider these conditions when assessing vulnerability and resilience of communities to natural disasters given the potential negative effect that they can have on villagers' trust and/or trustworthiness.

The first condition occurs when a natural disaster hampers the distribution of recovery resources because of availability and distribution constraints; a problem commonly observed in developing regions. This problem becomes even more dramatic when covariate (massive) natural disasters, such as earthquakes and floods, hit entire regions and the scale of damages go beyond a group of households. Although many efforts have been focused into deliver aid resources more efficiently in terms of covering people's necessities (Kovács and Spens, 2007), not always aid ends at households that needed it the most (or not that urgently as others) and cases of inadequate responses from local and international agencies when distributing help after natural disaster have been commonly reported in the past (e.g. Brodie et al., 2006, for Katrina hurricane). The reasons for this situation can go from political affinity of the aid provider-receiver to inefficiencies at the moment of gauging damages. In the immediate period after the natural disaster event this phenomenon may not be a problem for the trust of communities, given that households left behind have the hope of receiving aid in the near future. However, in the medium term, when people have not received support and realize that aid resources are not longer available, social

[1] Some authors name these characteristics as Cognitive Social Capital (e.g. Uphoff and Wijayaratna, 2000)

conflicts may surge within communities. Trust to each other, and trustworthiness inside communities, may be compromised as some received help while others did not.[2]

The second condition that natural disasters may provide for eroding trusting behavior among villagers is produced by what we call the *aftermath moral hazard*. Given that a covariate natural disaster is likely to affect a large population in a specific area, asymmetric information regarding suffered damages may facilitate the rupture of pre-established compromises or contracts between parties. A natural disaster provides the excuse to not longer fulfill responsibilities, given that a party will not necessarily know how importantly damaged its counterpart was. We named this asymmetric information surged by the natural disaster damages, the *aftermath moral hazard*. For instance, after hurricane Katrina hit New Orleans many people were relieved from long term debts and mortgages (Lawless, 2005), but not necessarily everybody needed this type of support –for the other part (in that case, the government) it is impossible to really assess how damaged every household was. Within communities the same type of phenomenon may occur as disasters provide people with arguments needed to avoid responsibilities with others. Statements like "I can't pay you back now, because I have to rebuild my home" or "all my assets are gone due to the disaster" may become frequent arguments when is not necessarily the case. The asymmetry of information prevents the other party to demand the fulfillment of the contract, which enhances the possibility of decreasing trustworthiness. Given that when future expectations collapse for a given reason, the previously trusted party can suffer from radically changed circumstances, so there is less reasons to expect trustworthy behavior (Hardin, 1996). Clearly expectations of people can collapse after the traumatic event given by a natural disaster and the *aftermath moral hazard* condition that may emerge, affecting negatively the trustworthiness among people of a community. The asymmetry of information prevents the other party to demand the fulfillment of the contract, which enhances the possibility of decreasing trustworthiness.

The third condition is produced by migration and/or displacement of people within communities. The former relates to the loss of trust that communities may face when people leave or arrive to a neighborhood. If, for instance, a small town gains population (from, for

[2] Extreme cases of this condition (for instance when aid resources are not distributed at all) may end up in social disrupts such as looting and robbery.

instance, a neighbor town that suffered considerably from a natural disaster) a new social structure may arise and trust may decrease.[3] A similar effect on trust and trustworthiness may surge as part of social displacement due to the reallocation of people inside communities, because of natural disasters' damages. A clear example is what happened in villages affected by the tsunami in Chile (after the 2010 earthquake), where many shantytowns created from emergency houses were established by the government inside the same communities, aimed to shelter families that lost their homes (what is known as *aldeas* in Chile). When these artificial neighborhoods last more than the expected (in Chile, one year after the earthquake they were still on place) feelings of mistrust to each other may arise as people are not voluntarily living with the people they have as neighbor. Supporting this evidence, Barr (2003) finds that within resettled communities (artificially) created after the civil war in Zimbabwe there is less trust between people, compared to trust between people living in traditional (original) communities.

Given these conditions, our research hypothesis is that the aftermath of covariate (massive) natural disasters adversely affect villager's trust and trustworthiness *to their fellow villagers*. We test this hypothesis by conducting a series of trust games in villages affected by the 2010 Chilean earthquake, one the strongest earthquakes ever recorded (Madariaga et al., 2010). We also conducted trust games in a group of villages non-affected by the earthquake in order to use their outcomes as control and comparison with the experiments carried out in the affected villages. If the patterns of response (the game's outcomes) between these group of villages differ, after controlling for other factors that may affect the behavior of people in the respective communities, we could infer whether a natural disaster aftermath affects people's trust and trustworthiness within communities, or not.

Despite the growing body of empirical literature that has used the trust game format to evaluate different responses of people under diverse conditions, to our knowledge no study has addressed how the aftermath of a natural disaster may affect people's trust and/or trustworthiness within communities. Results presented here suggest that the aftermath of the 2010 earthquake in Chile has decreased the level of trustworthiness among people of villages affected by the disaster. On average, players returned 10% less Chilean pesos in the earthquake area, than did

[3] Buchan and Croson (2004) show evidence that trust is positively correlated to the time people knows each other (social distance).

players in the control villages, for every Chilean peso "trusted" (given) from their counterparts in the trust game sessions. On the other hand, games outcomes that mimic trust behavior do not present statistical evidence of difference between groups. Hence, even though with this empirical approach we do not clarify what of the three described conditions (provided by natural disaster to affect trust) are taking place in Chilean villages, we do provide evidence that trusting behavior has been negatively affected. Results highlight an important aspect of human behavior, especially because a decrease of trustworthiness among fellow villagers can jeopardize the effectiveness of policy or programs aimed to relieve and support the resilience of communities affected by natural disasters.

The next section of the paper briefly reviews the role of trust/trustworthiness for economic development, and the contribution of the trust game for empirical studies. Section 2 also explains why this experimental design was used in our study. Section 3 states our research hypothesis, experimental design and identification strategy. Results are described in section 4. Section 5 discusses implications of results. Finally, we offer concluding remarks in section 6.

2. The importance of trust and trustworthiness

Trust and trustworthiness are commonly viewed as components of social capital. A high level of trusting behavior (which encompasses both trust and trustworthiness) is, generally, considered a factor that can enhance economic growth and social well-being (Morrone et al., 2009). Trust can be understood as "*the expectation that arises within a community of regular, honest, and cooperative behavior, based on commonly shared norms, on the part of other members of the community*" (Fukuyama, 1995, p. 26), which promotes less conflict and restriction between agents and therefore facilitates economic activity within them. Trustworthiness, on the other hand, relates to the fulfillment of expectations that somebody else puts in the person. Trustworthy behavior builds trust and reinforces institutions (Hardin, 1996).

Fukuyama (1995) argues that societies where people show trust beyond family ties have reached higher levels of economic development, compared to societies where trust is restricted to just family bonds (Fukuyama, 1995). Knack and Keefer (1997), using cross-country data, show a

positive correlation between trust and GDP per capita. The main arguments are that trust produces better government performances, less corruption, lower transaction costs, more redistribution, and finally economic growth. The idea of Fukuyama and the findings of Knack and Keefer have been supported lately by others studies that have relied on international and country level survey data to show that trust is an important factor for healthier economies (e.g. Alesina and La Ferrara, 2002; Calderon et al., 2002; Uslaner, 2005; Dearmon and Grier, 2009). On the other hand, empirical studies have also shown that trustworthiness is similarly relevant for communities' welfare (e.g. Karlan, 2005; Carter and Castillo, 2011). Comparing surveys and exrimental data, Glaeser et al. (2000) argue that the standard questions used in national (GSS in the US) and international (World Values) surveys in fact predict trustworthy behavior rather than trust. Thus, considering the vast literature correlating survey answers of trust to economic growth, the findings of Glaeser et al. (2000) imply that, at least, trustworthiness is as important as trust to build conditions for economic development. Both, trust and trustworthiness are relevant for the good performance of societies.

2.1 Natural disasters and trusting behavior

The consequences of natural disasters over developing (and developed) economies have gained the attention of many scholars. In one hand, macroeconomic studies have focused on the effect of natural disaster on macroeconomic conditions, productivity and markets (see Cavallo and Noy, 2010, for a survey). On the other hand, micro level studies among other issues have analyzed the role of insurance and coping strategies on the aftermath of natural disasters. However, scarce economic literature has investigated the role of initial social capital for natural disasters' recovery or how the aftermath of a disaster can produce the destruction or appreciation of communities' social capital endowment.

Considering that international and regional institutions are placing increasing resources to recover social and economic damages resulting from natural disaster events, understanding how trust and trustworthiness are affected in post-disaster environments is a key issue. Trusting behavior becomes a crucial factor given that, among other effects, contributes to the creation and consolidation of safety nets in the short term and to reinforce institutions and the effectiveness of

long term programs aimed to recover devastated regions. The empirical literature proving the role that initial social capital can have on post-disaster environments is scarce. Adger et al. (2005) and Munansighe (2007) provide some insights for future research, while Nakagawa and Shaw (2004), Carter and Castillo (2005), Mogues (2006), and Fleming (2011) are interesting initial attempts. However, in this study we focus on investigating the effect that natural disaster can have *over* social capital, especially in the levels of trust and trustworthiness that characterize a community.

As mentioned in section 1, the conditions that people can face in the aftermath of a natural disaster may end negatively affecting the trust and/or trustworthiness inside communities, which may jeopardize the path of recovery and economic resurge. However, to our knowledge there are no empirical attempts to analyze this argument, until now. Abstracting from natural disasters, the study of Alesina and La Ferrara (2002) states that past traumatic events correlates negatively with trust levels reported by people in the GSS survey conducted across the US. However, their finding only proves statistical evidence when traumatic events occurred within a year from the survey, while traumatic events occurred after one year had not significant relation to trust perceptions.

Our argument for the existence of a negative effect of natural disaster on trusting behavior is based on two main assumptions: 1) at least one of the three conditions described above (unequal/unfair distribution of aid, the aftermath moral hazard, and migration or social displacement) is present; and 2) the natural disaster is considerable important to affect most households in a region (a covariate natural disaster). If neither of this assumption is true, the link natural disaster-trust may be different. For instance, there are some studies that claim for a positive effect of natural disaster's aftermath over trust (Andrabi and Das, 2010; Cassar et al., 2011); however their evidence is not related to trust or reciprocity between people of the *same community*, as we attempt to analyze here. Trusting behavior is multidimensional, as it can be delivered to different types of agents (Morricone et al., 2009), so someone's trusting behavior

may increase in the aftermath of a disaster towards other agents (like donors or volunteers), but not necessarily towards your neighbor. [4]

2.2 Why the trust game?

Many researchers argue that experimental economics is an important contribution to the social sciences given that allows us to observe and measure behavior of people facing decision based on incentives (money, gifts, etc). Thus, as opposed to survey measures of trust and trustworthiness, economic experiments such as the trust game have the advantage of giving incentives to people to reveal the norms that guide their decision-making behavior, providing researchers of tools to empirically assess metrics of trust and trustworthiness. We conduct trust games as artefactual field experiment, which allow us to exploit the advantages of the experimental methodology with a sample of our population of interest: earthquake affected and non-affected villagers. Thus, together to complementary surveys, the observed behavior in the trust games can help us to identify whether or not trust and trustworthiness change in the aftermath of natural disasters.

Since its creation, many studies have used the trust game protocol (or similar versions of it) to observe trust and other human attitudes. Some empirical inquiries that have been investigated using the trust game are presented in table 1. As can be noticed, some researchers argue that different responses to particular conditions and particular aspects of people's behavior can be addressed with this experiment. For this reason the trust game has gained much attention and applicability in experimental economics –Johnson and Mislin (forthcoming) provide a meta-analysis of trust game results reported over 162 studies!

---Table 1 here---

Using the trust game in field experiments, Bouma et al. (2008) find a positive correlation between trust and participation of Indian peasants in community resource management; Karlan (2005) finds that trustworthiness is an important determinant of the success of group lending

[4] Andrabi and Das (2010) looks at trust levels towards strangers, while Cassar et al. (2011) analyses trust game outcomes of sessions composed of people of different villages.

programs among microcredit borrowers in Peru; and Carter and Castillo (2011) find that trustworthiness positively correlates with well-being after analyzing trust game outcomes in a sample of people that participated in both the games and longitudinal living standards surveys in South Africa.

The trust game has also been widely used in multi-country studies to compare outcomes and to try to understand cultural (country) effects on trust and trustworthiness (Willinger et al., 2003; Buchan and Croson, 2004; Cardenas et al., 2009). Comparing different groups of people within a country, Barr (2003) presents an interesting study where the trust game is conducted in resettled and original villages in Zimbabwe. Her study finds that resettled villagers present lower levels of trust while trustworthiness is unchanged between groups. Other interesting studies that directly compares social norms of two very different groups of players of the same country are Ockenfels and Weimman (1999) and Brosig-Koch et al. (forthcoming). Although they do not use the trust game design, these authors provide experimental evidence that East Germans behave in a more selfish manner than Western Germans do, years after the fall of the Berlin wall.

Finally, looking at natural disasters, Carter and Castillo (2005) use trust games' outcomes to explain the effect of trust on households' recovery after the pass of hurricane Mitch in Honduras in 1998. One issue of this study is that the authors assume that trust and trustworthiness among people did not vary after the pass of hurricane Mitch, ignoring the point that trusting behavior can change in the aftermath of natural disasters. In a recent working paper Cassar et al. (2011) use the game to observe trust levels among people 5 years after the 2004 Indian Ocean tsunami in Thailand compared to non affected ones. Differently from our study, their analysis is done conducting game sessions that mix people of different communities, missing the effect that the conditions provided by the aftermath of a natural disaster may have in the behavior of people inside communities.

3. Research Methods

3.1 Hypothesis

The null hypothesis of this research is that trust and trustworthiness do not show difference between people affected by a natural disaster and people not affected. The alternative hypothesis is that different trust/trustworthiness levels exist between groups, although we are inclined to find a negative relationship because of the aftermath conditions described above. However, we have to be open also to the option of an increase in the level of trust and trustworthiness in the aftermath of disasters. In this way, we will be evaluating three potential behavioral outcomes, given by:

- People in communities affected by a covariate natural disaster will tend to increase their levels of trust and trustworthiness for people of their communities. Potential causes: more community affinity given the necessity to work together to recover damages; increase in solidarity between neighbors; perceptions that new natural disasters may occur and therefore the support of others in the future becomes important; decrease in the degree of income disparity (so income inequality decreases); etc.

- People in communities affected by a covariate natural disaster will tend to trust less in people of his/her community. Potential causes are discussed in section 1.

- No change in trust and/or trustworthiness levels. No potential source of the above applies or, on aggregate, a combination of them, netting the potential change on the average behavior of villagers (null hypothesis).

3.2 Experimental Design

We based our experimental design on the trust game (*aka* investment game) first proposed by Berg et al. (1995). This is a one shot game, where each participant is faced to only one decision. The protocol that we used followed these guidelines:

a) Participants of the same community were invited and gathered in a room, two subgroups with equal number of people were randomly formed: group A and group B. Players of group A are designed to be the senders. Players of group B are designated to be the receivers.
b) The researcher explains that participants in group A (the senders) can anonymously choose to send part of an endowment, that will be given by the researcher (**p**), to some random participant in group B (the receivers). The money to be sent (**s**) can be any amount in the range $0 \leq \mathbf{s} \leq \mathbf{p}$. It is clearly stated that the final amount sent by the sender, **s**, will be converted to **3s** by the researcher.
c) Endowments are given and players of group B are moved to another room where they lose contact with participants of group A. Then players of group A move one by one to a secret booth where they decide how much to send. The money to be sent (**s**) should be put inside an envelope provided to participants. All remaining money should be kept in the pocket or purse (or similar) of the participant before leaving the secret booth, so other players do not notice how much has been sent.
d) Once all players A made their choice, we move to group B and receivers randomly pick one envelope containing the trusted money that has been multiplied by the researcher (3**s**). Receivers are asked to opt to return any amount (**r**) to the sender (who remains anonymous) in a secret booth. They can return any amount in the range $0 \leq \mathbf{r} \leq 3\mathbf{s}$ –the remaining money should also be secretly kept by the participant. After this, the sender receives (from the researcher) the money returned by the corresponding receiver, **r**, and the game concludes.

The values of **s** and the ratio **r**/**3s** are considered to be metrics of trust and trustworthiness, respectively. For our case **p** corresponded to $6,000 Chilean pesos (approximately 14 U$ dollars).[5] The endowment was given in $1,000 bills, so each player A has the set choice {0, 1, 2, 3, 4, 5, 6} to decide how to play. The amount received by player B (**3s**) was also provided in $1,000 bills, so they set choice was given by {0, 1, 2, … 3s}. One important difference of our setting to Berg et al. (1995) is that we did not use a double-blind procedure

[5] This is approximately one day of income, based on the average per capita income that our sample reported (see table 2).

given that the field experiment conditions prevented using it. However, for the implications of this study it does not seem to be a source of bias in our results –we discuss why below.

We carried out one session of the trust games across 10 different rural villages in Chile. Given that our main objective is to evaluate whether trust and trustworthiness have been affected in the aftermath of the Chilean earthquake within communities, we use two group of villages: 5 villages that were severely affected by the earthquake (treatment group), and 5 villages that were not (or much less severely) affected by this disaster (control group).

On every case, people of the same community were randomly selected and invited to participate in the game. 30 to 35 invitations were delivered per community. Delivery of invitations was done in person by one member of the research team. Only one person 18 years or older per household was allowed to participate in the game. The games were conducted in the public school of the town in 5 cases, while the rest were performed in the neighborhood's council center. In every case secret booths for game decisions were created and different rooms used to maintain people of groups A and B separated during the game. Initial and final remarks, together to the lottery game (described below), were conducted in a room with all participant sitting together. In this same room, at the begging of the session a raffle was conducted to randomly assign participants to group A and B. The raffle was based on the random chance of picking a colored marble from a black bag: people that picked the white marble were assigned to be in group A and people with the colored marble to group B. At the moment of explaining the game protocol people already knew their role. The game protocol was explained three times to the audience and questions were asked to check the understanding of participants.[6]

During downtimes (for players B while players A played, and for players A while players B played), participants were asked to fill out a small survey where main socioeconomic and demographic data was collected. The survey was recorded with the support of one research assistant. Envelopes with the money returned from receivers to senders (from player B to A) were handed out when people were leaving the session.

[6] Important to mention is that the researcher on charge of explaining the games' rules is Chilean and very familiar with the rural conditions and language deficiencies that participants may have had.

Finally, one instrument was performed to elicit risk behavior –based on a simple lottery game– after the trust game was completed, but before handing back the envelope with the money returned from receivers to senders –so players in group A did not know how much they have received back at the moment of choosing the lottery. Appendix A provides the description of this lottery game.

3.3. Identification strategy

The affected villages were selected from VII region of Chile, one of the most damaged regions of the country –see appendix B. Five villages were selected based on their level of destruction from the earthquake, their population at year 2002, isolation (distance from main cities), and main economic activity. Three villages were located in the coastal dry-land areas of the region (agricultural villages), and two were coastal towns (fishery villages).[7] We were concerned that across villages we would find people that were severely, modestly and barely affected by the earthquake, but we were more focused on selecting villages that shown an evident pattern of destruction one year after the earthquake.[8] Thus, we were not concerned about how importantly the earthquake hit a participant's household on a particular village, given that as covariate shock the earthquake did affect (at least emotionally) every subject on the area. We are more concerned on the aggregated effect of the earthquake, given that the interaction of people in the aftermath of the disaster has common community conditions for every villager.

Undoubtedly our statistical inference could be subject to endogeneity concerns if, for instance, villagers in non-affected areas behave more (or less) trusty or trustworthily between them because of cultural patterns or community affinity, compared to communities in the earthquake area. Thus, in our case we were concerned to find five non affected communities that have close characteristics to the ones evaluated in the VII region. In order to have a similar pool of villages we first selected 2 coastal villages from the IV region –the closest region of Chile to

[7] These coastal towns were also affected by the tsunami that followed the 2010 earthquake.
[8] This evident pattern of destruction means that a considerable number of houses had structural damages, much debris was still observable, and emergency houses and shelters were predominantly settled across space. Our data show that 76% of our participants in the earthquake area suffered considerable damages on their houses. However, important to clarify is that we did not use any "household damage" criteria when handing out invitations on every village, process that was kept as randomly as possible.

the VII region that reported neither shaking activity nor tsunami. In general, between these regions of Chile (IV and VII) people of coastal communities are alike in terms of cultural patterns. For the agricultural communities, however, cultural patterns may differ more across villages of Chile, and someone can argue that people from the north (IV region) are different form people of the south (VII region).[9] We addressed this potential issue by selecting one agricultural village per region going north from the VII region. Thus, as shown in the map of appendix B, we selected dry-land communities located in the VI, V and IV regions. We try in this way to avoid confounded factors affecting trust because of potential cultural differences of northern villages. In addition, all five control communities were similar to the earthquake ones by the other criteria: population at year 2002 and distance from cities.[10] Finally, even though there is no such a thing as a village equal to another, we show below that, on average, most characteristics of our participants on each group of villages did not differ statistically, which provides a good degree of reliability to results and interpretations provided below.

Regarding the trust games *per se*, all conditions of the experimental setting were replied as exactly as possible in every session across villages. In this matter, the integrants of the research team, the marble raffle, all materials of support (posters, envelopes, surveys, etc.), money at stake, anonymity conditions for playing, duration of sessions, and even the time of the day for handing out invitations and conducting the sessions were similar across all villages. Experiments were conducted during March 2011 (one year after the earthquake) in the earthquake villages, and during April–May 2011 in the control villages.[11] Contamination problems between villages were completely avoided given that villages were not necessarily close to each other and nobody, besides the research team, knew what villages were going to be selected to conduct the games. The single-blinded procedure used in our games should not bias our estimates considering that the use of the exact same research team should have affected game's actions, if did so, in a similar fashion across all sessions.

[9] However, within these regions of the country it can be argued that people in rural areas is culturally very similar in broad sense: vast majority of population is of the same race, of Hispanic origin (no indigenous roots) and follow Christian religion.
[10] Population of all 10 villages were in the range 185-300 people to year 2002 (last National Census in Chile). See map to see villages' approx. distance from cities.
[11] Luckily, across all cases, we never had rain or cold days that could have affected assistance.

Finally, as mentioned, invitations to the sessions were delivered by some member of the research team, who handed out invitations personally. With this practice we avoided self-selection of participants that potentially can occur when public announcements (posters, flyers, etc.) are used to invite participants to this type of games. Another important consideration is that invitations were given with no interference of local leaders, in order to maintain randomness in our sample and, again, avoid self-selection that could have arose from affinity or preferences of local leaders to the villagers to be invited.[12]

4. Results

In this section, we first present summaries of our data and statistical tests to observe if there is any difference between people from villages of the earthquake area and people from villages not affected by the earthquake (control). We then proceed to regression analyses to investigate the determinants of the games outcomes.

4.1. Data summary and statistical tests

On table 2, we first provide summary statistics for the main socioeconomic characteristics of our participants based on the group they belong to: treatment (earthquake) and control villages. As can be seen 120 participants played as senders (players A) and 116 as receivers (players B). The numbers are not matched because in 4 out of the 10 sessions we obtained an impair number of assistants, which was solved by adding one more participant into group A.[13] From the total number of participants, 121 belonged to villages of the earthquake area and 115 from the control villages.

---Table 2 here---

[12] Local leaders where contacted only to ask them assistance for getting a place where to conduct the games. When they volunteered to assist us in the invitations' delivery, we gently refused his/her help.

[13] Thus, one player A was not matched with a player B. We returned to this unmatched player A the same amount he/she trusted. Of course, given the anonymity of the game, no one knew whether they were left unmatched or not.

As shown in the last column of table 2, t-tests remark no statistical evidence of differences between groups in most of the variables reported, being the only exceptions *Marital_status* and *Trust_strangers*. Table 3 presents descriptive statistics and tests for our two variables of interest: *trust* (***s***) and *trustworthiness* (***r/3s***). The dominant modes for ***s*** and ***r/3s*** are similar across groups. The mode of trustworthiness, 0.33, represents the ratio given by returning the same amount that the sender sent. In other words, the mode signals that in several cases the receivers returned the same amount sent by the sender (**s**), and kept for themselves the amount added by the researcher (**3s – s**).[14]

---Table 3 here---

As we can observe in the bottom half of table 3, the pattern of behavior remarked by trust does not present statistical evidence of divergence. People in the earthquake area as well as people in the control area sent, on average, similar amounts of money to receivers. Levene's test conducted to compare variances of groups show no statistical evidence of difference between groups for trust and trustworthiness. However, the statistical tests provide evidence that trustworthiness is different between groups, implying (based on the mean and median of both groups) that people in the earthquake area present lower levels of trustworthiness to their fellow villagers than people in non-affected areas. These are clear results showing a non-similar pattern of behavior between people of the two areas.

Figure 1 and 2 depicts the cumulative frequencies of trust and trustworthiness, respectively. It can be clearly noted how the curves of trust are much alike between groups, while the trustworthiness ones differ considerably.

---Figures 1 here ---charts

4.2. Regression analysis

Table 4 and 5 present OLS results of models that predict the observed levels of trust and trustworthiness across villages, respectively. As done in previous studies that model outcomes of the trust game (e.g. Croson and Buchan, 1999; Sutter and Kocher, 2007; Buchan et al., 2008), we

[14] This is a common result evidenced in several studies using the trust game.

include as basic covariates *Age*, *Education*, *Religion*, and *Gender*, *Marital_status* and the income reported by the player.[15] As can be noticed *Age* appears as the main predictors of trust levels across models. In models 2 and 3 the variable *Lottery* (variable that attempts to captures the willingness to take risks from the participants –see appendix A) is positive and significant, and in model 3 improves the fit of our model to the data in more than 30% (same 111 observations without *Lottery* reported a R^2 of 0.23). The positive and significant correlation between ***s*** and *Lottery* provides evidence of what Karlan (2005) claims, and contradicts what Eckel and Wilson (2004) found (see table 1).[16] Interestingly, when we include *Lottery* in our model the variable *Gender* becomes significant showing that after controlling for risk aversion, women opt to send more money than men, result in line to what Schechter (2007) finds in rural villages in Paraguay. The variable *Earthquake dummy* (treatment dummy: 1 if subject belongs to a village in the earthquake area, 0 otherwise) shows no significant effect, supporting the evidence of table 2.

The model of our trustworthiness regressions are based on the same covariates used to explain trust. One exception is that ***s*** is also added as control variable for predicting ***r/3s***. We exclude *Lottery*, as in this stage participants are not dealing with a "risky decision" (whether to trust or not) and we include a squared value of *Age* –which proved to be statistically significant and improved the predictability of our models. An important variable that in this case showed to be important is *Trust_town*, which has a positive and significant coefficient across models (not included in the trust model results reported because it proved to be never significant). This last result is in line to other studies that state that standard attitudinal questions about trust predict trustworthy behavior of people (e.g. Glaeser et al., 2000; Ashraf et al., 2006). The somehow puzzling negative and significant coefficient of ***s*** can be explained by the ratio used as dependent variable (***r/3s***). If we take elasticities on the sample means, it can be shown that the negative coefficient is just showing that player B tends to return amounts close to what Player A sent (close to ***s***), in line to the dominant mode of the sample (reported in table 2). In models 4.1 and 5 we exclude observations given by potential outliers that did not understand our game. These participants returned all the money that they received (***r/3s*** = 1), which may show that they

[15] We used a categorical variable (*Inc_qtl*) based on the respective income quintile that the player belonged within our sample. The use of this variable proved to be more informative across our models.

[16] Eckel and Wilson (2004) use the Holt and Laury (2002) lottery game. We tried a simple version of this game in our first session, and proved to be very confusing for people –fact that has been evidenced by results of other researches using this framework (e.g. Jacobson and Petrie, 2007). Given this confusion, we moved to the simple coin-toss lottery game (described in appendix 1), in the remainder of our 9 game sessions.

were confused about the one-shot characteristic of the trust game, although their responses could have been explained also by high kindness of their part. Regardless this last possibility, we preferred to exclude them from our sample in results reported on columns 2 and 3. After excluding these outliers we can observe an interesting significant inversed–U relationship between age and trustworthiness, peaking at approximately 60 years. *Education* also shows to be important, where for each additional educational category a player has, the returned money increased by approximately 2%.

---Table 4 and 5 here---

In our different trustworthiness models *Earthquake dummy* is negative and significant. This shows that after controlling for players characteristics, people in the earthquake villages behave less trustworthily than villagers in the control area.

If the reader is not convinced by the identification strategy used (i.e., by the suitability of our counterfactual villages), it can be seen that model 5 including village dummies shows that after controlling for the potential cultural heterogeneity or other unobserved village characteristics, the earthquake villages still present statistical evidence of lower trustworthiness than the control group. To avoid perfect multicollinearity between *Earthquake dummy* and the village dummies in model 5 we dropped one community dummy per group: the village showing the highest trustworthiness in the control area and the village reporting the lowest trustworthiness in the earthquake area (so the gap in the average trustworthiness levels between groups diminishes).

As robustness analyses we try regressions of model 4.1 restricting our sample in different ways, obtaining negative and significant coefficients for *Earthquake dummy* across cases.[17] On average we estimate that players of group B in the earthquake villages returned approximately 10% less than players in the control area, for every Chilean peso sent (trusted) by their respective

[17] When restricting observations by excluding outliers, the village with the highest average per capita income and coastal villages, we obtained an *Earthquake dummy* coefficient of –0.10** (n = 61). When restricting observations by excluding outliers, the village with the highest average per capita income and agricultural villages, the coefficient is –0.10*** (n = 43). Excluding observations from the village with the average lowest trustworthiness reported in our sample, the coefficient is –0.07** (n = 94).

counterpart on group A. The average behavior of people in the aftermath of the Chilean earthquake is to behave less trustworthily than people in non-affected areas.

5. Discussion and implications of results for disaster resilience

Why has trustworthiness changed while trust has remained similar between village groups? Based on the expected trustworthiness theory (Barr, 2003) we should have expected lower trust levels in villages affected by the earthquake, if trustworthiness has decreased. However, we can postulate two points to explain why we do not observe differences in the trust responses between groups. First, we can recall evidence supported in past studies that trust measures are not reliably gauged with trust games (e.g. Glaeser et al., 2000; Karlan, 2005). The outcome that we observe can be biased by risk preferences of participants. Our data report that participants playing as senders in both group of villages behaved similarly when facing the lottery game (see note to table A1 in appendix A), which may explain why trust measures are not different between groups. Second, as evidenced by Ashraf et al. (2006), senders "trust" even though they know that it does not pay monetarily, implying that there are other attitudes like unconditional kindness explaining player A decisions. As a matter of fact, we asked players A (senders) if they thought they would make money or not with the game, and only 16% of our sample thought so.[18] 82% and 86% thought that they would make less or no money from the amount sent to player B in the earthquake and non-affected villages, respectively –responses are not statistically different between groups (t-test, $p<0.57$, two tailed). In this way, suspecting of confounded trust–risk behavior and/or the influence of kindness in players' A decisions, and considering that both attitudes (risk behavior and kindness) shown to be statistically no different between players in both groups of villages, we can explain why we cannot reject the hypothesis that trust levels (differently from trustworthiness) are similar between groups.

The observed behavior of players of group B do not present the problems described above mainly because it has been widely empirically supported that the measures of trustworthiness from the trust games are reliable (e.g. Karlan, 2005). We claim that the earthquake has had an important effect on people's behavior regarding trustworthiness. In

[18] The question was made when conducting the respective surveys to players A.

explaining this claim, we suggest that player B behaves differently in villages affected by the earthquake because the aftermath of the disaster provides them of excuses to no reciprocate, to no consider their neighbors (their potential matched player) in her actions. A covariate natural disaster provides excuses to break pre-established social-contracts, based on what we called *aftermath moral hazard*. Another explanation relates the understanding that reciprocity can be determined by strategic behavior: player B does not face the financial risk than player A faced, but they face a decision that can affect future interactions within communities. In this argument our first described condition that an aftermath provides to alter trusting behavior enters: people in the aftermath of the earthquake may have perceived (or suffered of) unfair and unequal provision of aid resources, which may influence them to not consider their fellow villagers when deciding whether to reciprocate or not. Finally, another attitude that may explain behavior of players B in our sessions is that people in the aftermath may opt to kept more money for them given the uncertain conditions that they perceive after the disaster: as post-disaster conditions are not solved, people can have higher uncertainty about the future occurrence of new disasters or economic downturns.

Different researches have shown that trustworthiness is relevant for healthier economic systems (Carter and Castillo, 2011; Hardin, 1996; Karlan, 2005). Moreover, it becomes even more relevant if we consider that the best device for creating trust is to establish and support trustworthiness (Hardin, 1996). With low levels of trustworthiness, trust becomes worthless. Hence, in terms of policy it can be argued that enhancing trustworthiness will provide better environments to economic activity and the operation of relief programs, as well as increase levels of trust, which will induce more productive cooperation and rapid recovery from disasters. Trusting behavior can be enhanced by introducing regulations, such as the law of contracts, to improve relationships and to make parties more trustworthy (Hardin, 1996). If trustworthiness can be harnessed and/or identified by planners in post-disaster conditions, the resilience of communities can be fortified as we solve failures observed in institutions aimed to support safety nets and recovery, especially for the poorer ones.

On the other hand, there may be added benefits from ensuring that people receive adequate assistance after disasters and social displacements are planned with caution. A transparent and equal distribution of aid (that is based on people's real damage) can avoid the

problems that we described above and that end on the erosion of trust and trustworthiness. Even such assistance may lead to greater trusting behavior if unfairness feelings are avoided from unequal distribution of aid. If policies are consistent and clear, planers can avoid higher deterioration of trusting behavior, promote more trustworthiness among villagers and therefore positive effect on trust and subsequent growth. Similar effect can happen by improving programs aimed to facilitate migration or social displacement. If these policies are well planned (ideally together to affected household leaders) and with clear future steps (periods, places of reallocation, etc.), the restructuration of communities can occur with less problems and thus avoid the surge of feelings of distrust among people.

Finally, important to state is that not necessarily the aftermath of a disaster will decrease all types of trusting behaviors on people. There exists evidence that suggests that trust to strangers may increase during or after the aftermath of natural disasters given that the role of non-local donors (aid givers) contributes to the formation of positive attitudes towards foreigners (Andrabi and Das, 2010). Comparing to our case, we do find kind of similar pattern in our data. After the standard question, how much do you trust in strangers? (asked in our survey and reported in table 2), we find that villagers in the earthquake area trusted strangers more than what villagers in the control area did. Although values are low, difference between groups is significant (t-test, $p<0.01$, two tailed) pointing out that people in the aftermath of the earthquake is more open to interact with strange people, although that is not necessarily traduced into more trust/trustworthiness within villagers, as evidenced here.

6. Concluding remarks

Natural disasters and their catastrophic consequences may not only provide structural damages and markets' malfunction in entire regions, but the conditions provided by their aftermaths can also can also affect the endowments of communities' social capital. In this research we postulate three conditions, likely to occur after massive natural disasters, that can adversely affect the trusting behavior of people, a crucial component of social capital within communities: rivalry for limited relief and recovery recourses, increment of information asymmetries between agents (what we call *aftermath moral hazard*) that provides excuses to break pre-established-social

contracts, and migration or social displacement of people. To investigate if the aftermath of a massive natural disaster affects trust inside communities, this research implemented a series of trust games conducted in rural villages of Chile one year after the 2010 earthquake. Experiments were conducted on a group of villages that were heavily affected by this disaster and in villages that did not suffer consequences (villages that act as control group). Game outcomes and additional socioeconomic data collected with surveys are compared and analyzed by statistical tests and regressions. Evidence from this experimental setting shows that trust levels (and most socioeconomic characteristics of participants) are not statistically different between groups, but trustworthiness levels of affected villages are lower than levels observed in control villages, supporting our argument that aftermath conditions can negatively affect trusting behavior.

Results provided here highlight an important aspect, given that a decrease of trustworthiness among fellow villagers can jeopardize the effectiveness of policy or programs aimed to relieve and support the resilience of communities affected by natural disasters. Although with the implemented empirical approach we do not clarify what of the three described conditions (provided by natural disaster aftermaths to affect trust) are taking place in Chilean villages, we do provide evidence and insights for future research about this important issue.

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Appendix A. Lottery game

We created a very simple lottery game, adapted from the idea of Binswanger (1990), to assess how likely a particular player was to take risks. The game was conducted at the end of each session (with the exception of the first session, as mentioned in footnote 16), but before we handed out the enveloped with the amount of money returned from player B to A (from receivers to senders) in the trust game. Thus, players A did not know before-hand how much they had "win" (or "loose") in the trust game, but player B knew about her gains.

The design of the game was offering $2,000 Chilean pesos (U$4, approx.), in expected value terms, with 6 different options. In specific, we asked each player to choose 1 out of 6 options, from no- to high-risk as shown in table A1. The outcome of each option was decided by a coin toss (made by the player). Table A1 shows the different options given and the potential outcome that players faced on each option, as well as summary statistics of our sample. The lottery option chosen by a player corresponds to the value of our *Lottery* variable. As can be noticed players in group B were much more willing to take risks than players A, behavior that is clearly influenced by the information that they had from the trust games outcomes.

---Table A1 here---

Appendix B. Map

---Figure 2---Map

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Table 1. Some inquiries investigated with trust games, selected studies.

Study(ies)	Inquiry researched	Findings
Ashraf et al. (2006)	Decomposing trust and trustworthiness	Authors claim that trust is predetermined by unconditional kindness and expectations of return, while the variance of trustworthiness is explained by unconditional kindness and reciprocity.
Bohnet & Zeckhauser (2004), Bohnet et al. (2008)	Betrayal aversion	Authors find that players are less willing to send high rates of **s** when they face a human counterpart rather than just the (random) chance of receiving money back (a lottery).
Buchan & Croson (2004)	Social distance effect on trust	Authors claim that trust and trustworthiness is high between partners who are closer to them in social distance. This last concept is abstracted from parents and siblings all the way to strangers of other cities.
Willinger et al.(2003), Buchan & Croson (2004)	Cultural implications for trust	The first study compares trust behavior observed in games carried out in China and the US, and the second in Germany vs. France. Both studies find higher levels of trust in the former countries.
Eckel & Wilson (2004)	Risk aversion behavior	Authors compare trust games outcomes, especially **s**, with answers to psychological tests aimed to measure risk attitudes and the Holt & Laury (2002) lottery game. Results show no correlations.
Glaeser et al. (2000), Karlan (2005)	Reliability of trustworthiness and trust measures	Authors claim that **r/3s** measures trustworthiness. However, they argue that **s** is not a consistent metric of trust, but more an assessment of the subject's propensity to take risks.
Sutter & Kocher (2007)	Change on trust over age cohorts	Authors find that trust varies across people age's cohorts. Their finding states that the older the cohort, the lower the trust.

Source: Own elaboration. Note: **s** and **r**/**3s** are considered to be metrics of trust and trustworthiness, respectively (see text).

Table 2. Main statistics of players' characteristics by group and statistical tests for equality of mean between groups. [a]

Variable	Description	Earthquake villages	Control Villages	t-test
Gender	Dummy variable, 1 if female	0.73	0.69	0.41
Marital_status	Dummy variable, 1 if married	0.61	0.67	**0.07***
Religion	Dummy variable, 1 if Catholic	0.80	0.83	0.64
Age	Age of the player	48.37 (51) [17.1]	49.37 (48) [15.2]	0.36
Time_town	Number of years living in town	35.33 (34) [21.9]	35.09 (37) [19.9]	0.93
Education	Level of education, scale 0 (no education) to 5 (12 years of education or more)	2.20 (2) [1.3]	2.40 (2) [1.2]	0.21
People_household	Number of persons living in household	3.24 (3) [1.5]	3.25 (3) [1.6]	0.91
Income_pc	Household per capita income (thousands of Chilean pesos)	53.63 (37.5) [6.4]	60.97 (50.0) [4.1]	0.15
Trust_town	Reported trust to people of village, scale 1 (no trust) to 4 (high trust)	2.07 (2) [0.9]	2.10 (2) [0.9]	0.75
Trust_strangers	Reported trust to strangers, scale 1 (no trust) to 4 (high trust)	1.66 (1) [0.9]	1.37 (1) [0.9]	**0.01****
# of Participants [b]		121	115	
Trustors (group A)		61	59	
Trustees (group B)		60	56	

[a] Statistics: Mean (median) [standard deviation].Test values correspond to two–tailed p–values.
[b] Number of participants do not match between senders and receivers because in 4 out of 10 sessions we had an uneven number of participants. See text for more details.

Table 3. Main statistics of game outcomes and statistical tests. [a]

	Trust (*s*)		**Trustworthiness (*r/3s*)**	
	Earthquake	Control	Earthquake	Control
Dominant Mode	2	2	0.33	0.33
Mean (median)	2.31 (2)	2.24 (2)	0.28 (0.22)	0.38 (0.33)
Standard deviation	1.56	1.25	0.24	0.22
	Statistical tests for differences between groups [b]			
t-test for equality of mean, equal variance assumed	0.77		**0.03**** [**0.00***]	
t-test for equality of mean, equal variance not assumed	0.77		**0.02**** [**0.00***]	
Mann–Whitney U test for equality of distributions	0.78		**0.00***** [**0.00***]	
Levene's tests for equality of variance	0.29		0.60 [0.69]	

[a] Six players of group B (4 in the earthquake area and 2 in the control villages) could not play because they receive $0 from the sender. These six cases are neither included in the results reported here nor in the regression estimations.
[b] Test values correspond to two–tailed p–values. Squared brackets show p–values of sample excluding outliers given by $r/3s = 1$ (six observations in total, three on each group).

Table 4. Regression results of models predicting trust [dependent variable: ***s***].

	Model 1	Model 2	Model 3
Constant	0.109 (0.803)	0.017 (0.883)	0.487 (0.791)
Gender	0.321 (0.287)	**0.637** (0.299)**	**0.673** (0.291)**
Marital_status	–0.318 (0.267)	–0.331 (0.286)	**–0.450** (0.287)*
Religion	**0.475** (0.264)*	0.415 (0.292)	0.343 (0.308)
Age	**0.025** (0.011)**	**0.022** (0.012)*	**0.021** (0.011)*
Education	0.126 (0.132)	0.049 (0.146)	0.210 (0.136)
Inc_qtl	0.054 (0.102)	0.042 (0.120)	–0.085 (0.114)
Lottery		**0.138** (0.076)*	**0.289** **(**0.090)***
Earthquake dummy	0.097 (0.282)	0.005 (0.291)	
Community dummies	*no*	*no*	*yes*
Nº Observations	120	111	111
R^2	0.12	0.13	0.31

Notes: Robust standard errors in parenthesis. Not reported town dummies are included in model 3. Number of observations varies because *Lottery* was not assessed in one village (see footnote 16).
*p < .10. **p < .05. ***p < .01.

Table 5. Regression results of models predicting trustworthiness [dependent variable: ***r/3s***].

	Model 4	Model 4.1	Model 5
Constant	0.173 (0.226)	–0.083 (0.146)	–0.089 (0.148)
*Trust (**s**)*	**–0.050** (0.013)***	**–0.031** (0.010)***	**–0.04** (0.010)***
Gender	0.012 (0.041)	0.008 (0.032)	–0.008 (0.035)
Marital_status	0.037 (0.050)	0.037 (0.030)	0.044 (0.032)
Religion	–0.044 (0.070)	0.009 (0.043)	0.040 (0.044)
Age	0.004 (0.007)	**0.009** (0.005)**	**0.008** (0.005)*
Age^2 (x100)	–0.004 (0.006)	**–0.007** (0.004)*	–0.007 (0.005)
Education	0.002 (0.018)	**0.022** (0.013)*	**0.021** (0.012)*
Inc_qtl	0.029 (0.018)	**0.020** (0.011)*	0.009 (0.011)
Trust_town	**0.069** (0.028)**	**0.051** (0.014)***	**0.053** (0.015)***
Earthquake dummy [a]	**–0.09** (0.044)**	**–0.091** (0.029)***	**–0.19** (0.084)**
Community dummies	*no*	*no*	*yes*
Nº Observations	110	104	104
R^2	0.18	0.33	0.44

Notes: Robust standard errors in parenthesis. Not reported community dummies are included in model 5. All models exclude participants receiving $0 from senders and models 4.1 and 5 exclude outliers that played ***r/3s*** = 1 (see text) –results including outliers in these models give similar structural coefficients but lower values of R^2.
*p < .10. **p < .05. ***p < .01.
[a] We avoid perfect multicollinearity between *Earthquake dummy* and the community dummies in model 5 by dropping two, instead of one, community dummies from the regression (see text for more details).

Table A1. Coin–toss lottery game options and summary statistics of *Lottery*. (mean) [standard deviation].

Option	Tails ($)	Heads ($)
1	2,000	2,000
2	1,500	2,500
3	1,200	2,800
4	800	3,200
5	500	3,500
6	0	4,000
	Player A	Player B
Earthquake villages	(2.36) [1.97]	(1.82) [1.48]
Control Villages	(2.26) [1.60]	(1.92) [1.44]

Notes: Values ($) are in Chilean pesos. We find no significant difference in how players A played between the 2 groups of villages (t-test, $p<0.77$, two tailed).

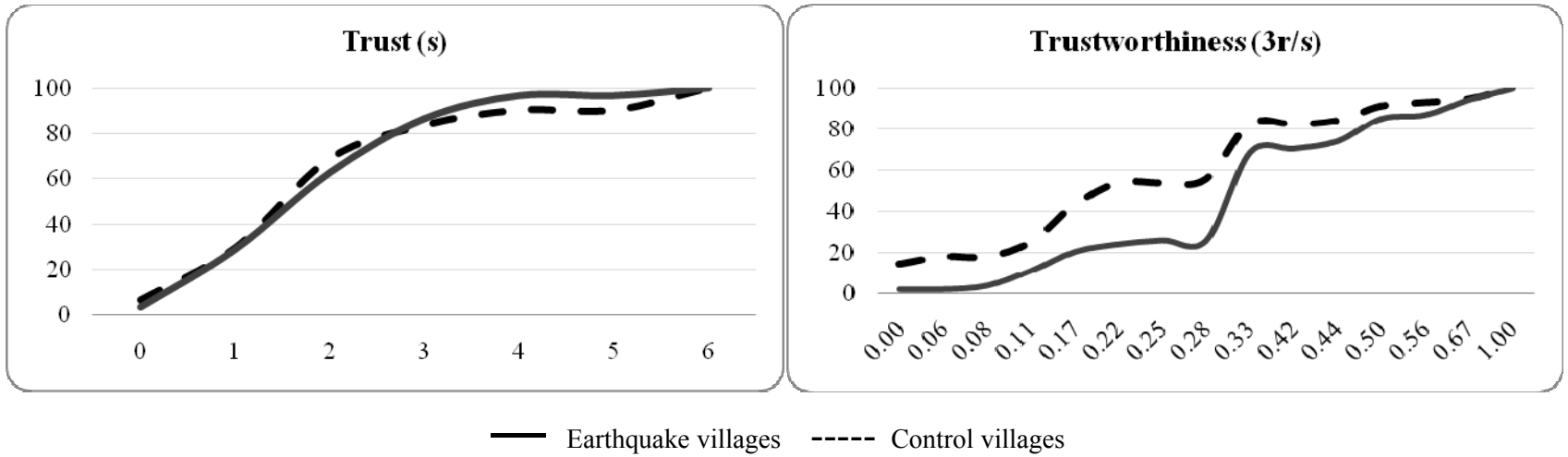

Figure 1. Cumulative frequencies of trust and trustworthiness levels in both groups of villages.

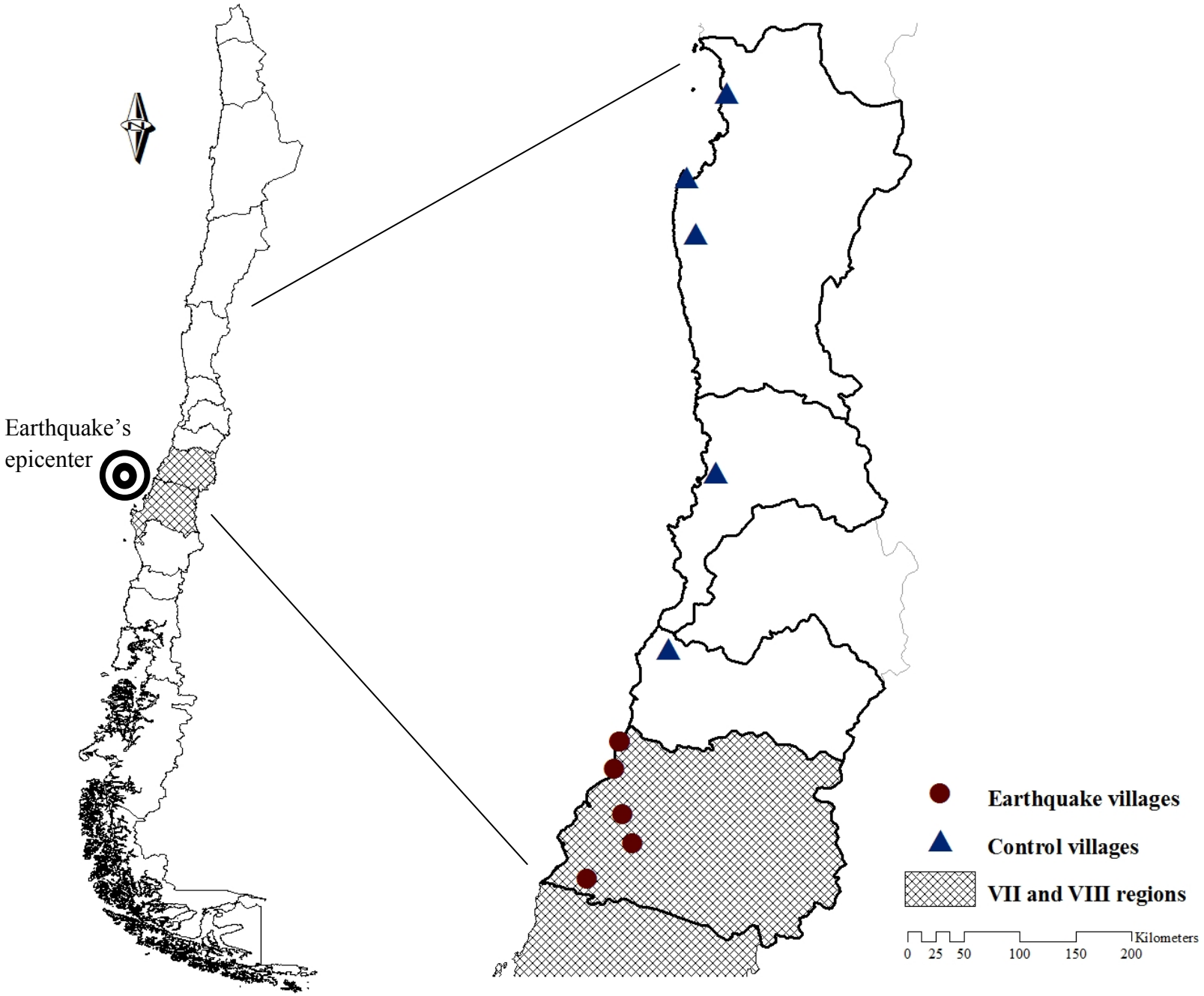

Figure A2. Map of Chile and location of studied villages.