Social Capital, Trust, and Collective Action in Post-earthquake Nepal

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Abstract

First-generation theories of collective action suggest that self-utility maximizing individuals in a setting characterized by high degrees of non-excludability and non-rivalry prefer the dominant strategy to evade cooperative choices and instead opt to free-ride. However, an overwhelming number of successful and unsuccessful collective action efforts documented worldwide in the aftermath of natural disasters contradicts this notion. This paper argues that second-generation theories of collective action forwarded by Elinor Ostrom and others bridge this theoretical-empirical divide. We posit that a social norm-based model of human behavior, not confined within a purely atomistic, material payoff maximizing mindset, provides a more consistent analytical framework to explain post-disaster collective activities. Using primary data that we collected from Sindhupalchowk, Nepal following the 2015 earthquake, we empirically demonstrate that bonding social capital fosters mutual trust, which in turn creates a milieu conducive to collective action efforts. Besides this mediated effect, we find that both bonding and bridging/linking social capital also have direct effects on post-disaster collective action. This paper presents social capital as the key determinant of self-governance and resilience in post-disaster situations that require concerted efforts from citizens, the private sector, and public institutions towards overcoming the common challenges of rehabilitation and reconstruction.

Keywords: Natural disasters, collective action, social capital, trust, resilience, Nepal

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Until a theoretical explanation – based on human choice – for self-organized and self-governed enterprises is fully developed and accepted, major policy decisions will continue to be undertaken with a presumption that individuals cannot organize themselves and always need to be organized by external authorities.

Elinor Ostrom, Governing the Commons (1990)

Introduction

The issue of post-disaster recovery is a complex one, requiring concerted efforts from public institutions, private firms, and, most importantly, from citizens. The recovery rests on the synchronicity of multiple factors: timely return of residents to the devastated community, coordination of public and private institutions in recovery efforts, readiness of the private enterprise to reopen businesses and organizations, and so on, all of which are directly or indirectly determined by the community's social capital endowment. In that sense, both household and community recovery can be characterized as collective action problems (CAPs) that require multi-level collaboration. However, in communities characterized by low levels of social capital, such collaboration can prove to be an elusive quest. Extant scholarship on disaster resilience has established social capital as a potential driver of post-disaster resilience (Aldrich, 2012a; Buckland and Rahman, 1999; Nakagawa and Shaw, 2004; N. M. Storr et al., 2015). In fact, Aldrich (2012b) argues that social capital serves as a core determinant of post-disaster recovery— more so than a multitude of commonly referenced socioeconomic factors, magnitudes of disaster damage, population density, and external assistance. This is especially true in many developing economies mired in rampant poverty and institutionalized corruption, where public institutions hurt rather than help the recovery process by crowding out internal resources and external assistance. In such cases, social capital plays an even more central role in

post-disaster relief, rehabilitation, and recovery processes (Chamlee-Wright and Storr, 2010; Wetterberg, 2004). However, if the overarching goal is to develop a thorough understanding of the workings of social capital, we ought to move away from its black-box characterization and further scrutinize the causal chain that connects it to post-disaster resilience.

Since extant scholarship establishes that (a) post-disaster recovery can be characterized as a collective action problem, and that (b) social capital is a core determinant of post-disaster recovery, from (a) and (b), it follows that social capital can contribute to post-disaster recovery by overcoming collective action problems. While it is intuitive that working as a collective unit rather than as atomized individuals makes recovery efforts exponentially more impactful, rigorous empirical demonstration of this causal channel is scarce. In an effort to illustrate this causal link, Aldrich, (2012a) postulates three channels by which social capital can foster collective action: establishing new norms about compliance and participation; providing information; and enhancing trust. In a different but related work, Aldrich (2012b) argues that neighbors with high levels of trust are able to share information about bureaucratic procedures and upcoming deadlines as well as deter post-disaster crimes. On the other hand, higher levels of general trust also increases chances of organization and resource-pooling (Olshansky et a., 2006), which can improve access to loans, supplies, and other resources (Dow, 1999). Isolating each of these causal channels is an empirical nightmare. Clean laboratory experiments can resolve many identification issues, but the transferability of laboratory findings to real world post-disaster scenarios is easily controvertible. All these challenges are further exacerbated by concerns surrounding the allegedly abstract nature of the notion of social capital. As a result, this potentially important causal link has only received a cursory attention in the current disaster studies scholarship.

In this paper, we leave aside inquiries into the broader social capital-recovery link. Instead, taking Aldrich's (2012b) hypothesis as an axiomatic premise, we focus on illustrating one of the causal mechanisms by which this link is materialized in a post-disaster setting. We employ Ostrom & Ahn's (2008) social capital-collective action framework, – in which trust is presented as "the core link" that connects social capital to collective action – as a theoretical motivation and proceed to empirically illustrate this mediatory role. For the empirical demonstration, we employ primary household data that we gathered from Sindhupalchowk, Nepal following the devastating 7.8 magnitude earthquake in 2015. Because this study concerns itself with individual-level motivators of collective action, we envision social capital as endowment that is not confined to meso- or macro- levels of analysis, but rather defined by an individual's access and participation in different types of voluntary associations and social networks. We employ a series of econometric techniques, including structural equation models and mediation analysis, and demonstrate that [bonding] social capital, mediated by mutual trust, can create an environment where individuals can voluntarily engage in collective action efforts to overcome post-disaster challenges. In doing so, we provide evidence against Mancur Olson's pessimistic portrayal of atomistic individuals, who, in following their individual self-interest, fail to achieve their common or group interest and thereby get perpetually entrapped in a post-disaster dilapidation (Olson, 1965). The purpose of our empirical demonstration is to present social capital as an adhesive that individuals can, under certain institutional contexts, employ to build mutual trust among one another, which in turn can be mobilized through collective action to elevate themselves from their otherwise "*solitary*, poor, nasty, brutish, and short" lives (Hobbes, 1651).

Previous Research

How can atomized, self-interested, and rational beings, who are primarily motivated by their own immediate payoffs, rise above their parochial individual interests and collaborate for joint benefits if each has ample opportunities to free-ride on the efforts of others? The first generation collective action theorists suggest that they cannot – that is, unless we employ an external, often coercive external authority to change the underlying incentive structures or privatize the whole enterprise (Hardin, 1968; Olson, 1965). Influential works of second generation collective action theorists, including prominent scholars like Elinor Ostrom, have definitively refuted the first generation conclusions. If the underlying institutional rules are incentive compatible and a broad set of 'design principles' are rigorously applied, individuals can and do successfully coordinate (Ostrom, [1990] 2015). Through a series of extensive case studies and systematic meta-studies, Ostrom debunks the naïve either-market-or-state dichotomy, and makes a convincing case for self-governance (Aligica, 2016). But, as a meticulous empiricist whose works are reflections of her "learning from the people" principle, she is careful to specify the type of "organism" that she is studying, namely the common-pool resource (CPR), and even warns against "policies based on metaphors" (Ostrom, [1990] 2015, p. 23-26). In that sense, extending Ostrom's 'design principles' to a natural disaster setting constitutes a violation of the very foundations that her principles are based on. Nonetheless, her conclusions concerning individuals' ability to consolidate their collective efforts and resolve many common challenges are not unique to CPRs, and are pervasive in diverse settings including in post-disaster scenarios.

Recent decades have seen a surge of literature on collective action and public goods provision, particularly coming from laboratory-based applications of game theory (Chaudhuri, 2011; Poteete et al., 2010). These experimental games have largely debunked the textbook model of

self-utility maximizing *Homo economicus* wo/man that occupied the core of standard economic theories. Contrary to the blackboard economic theories, individuals willingly offer money to strangers even when presented with hoarding opportunities (Camerer and Thaler, 1995; Oosterbeek et al., 2004); they sacrifice strict economic payoffs over values such as fairness (Hoffman et al., 2007), cultural norms (Henrich, 2004), and cooperation (Fehr and Gächter, 2002; Henrich, 2004). However, when studying the role of social capital, of interconnectivity between individuals, experimental studies that typically presuppose conditions of anonymity and randomness hit the wall. Gurven and Winking (2008), in a study concerning pro-socialness, show that human behavior within a game of experimental studies bears little or no resemblance to the "context-rich environment" of the real world where people make decisions. Post-disaster scenario is one such "context-rich environment," whose conditions are near-impossible to replicate in a laboratory setting. Moreover, when the study pertains to both prosocial behavior and a post-disaster context, the transferability of such laboratory findings to the real world requires a major leap of faith, which we do not dare take.

Reports on post-disaster collective action for evacuation, provision of public goods, restoration of public utilities, and increasing access to resources are ubiquitous. Aldrich (2012a) lists a series of cases from across the globe where communities have engaged in collective action following major disasters: locals in some neighborhoods organized to plan cooperative, fireproof housing following the 1995 Kobe earthquake in Japan (Olshansky et al., 2005); residents organized watch communities to prevent theft after the 2010 Haiti earthquakes (Burnett, 2010); In Manitoba, Canada, many coordinated communities engaged in evacuation activities following the Red River Flood (Buckland and Rahman, 1999); In Mexico, *los damnificados* (victims) formed collective union to pressure the government to provide housing (Ovalle, 2010); in New Orleans,

following Hurricane Katrina in 2005, some residents mobilized the local church to provide club goods to encourage others to return to their communities (Chamlee-Wright and Storr, 2009). In light of these cases, one may incontrovertibly say that individuals often engage in many post-disaster collective activities defying all *Homo economicus* orthodoxies: they often forgo direct economic benefits, engage in charitable efforts that do not directly benefit themselves, and choose not to free-ride even when presented with ample opportunities to do so. Although appealing to an altruistic model of human behavior is one way we could rationalize these phenomena, doing so puts us in a blind-spot since we do see a rise in illegal and disruptive activities in many instances (Lee and Bartkowski, 2004). Social capital, on the other, allows us to explain such prosocial behaviors during post-disaster contexts without appealing to a stringent model of human behavior.

Field survey studies on the socioeconomics of natural disasters are abundant (e.g. Alam & Rahman, 2014; De Mel et al., 2012). A similarly large body of literature exists on social capital (Dasgupta, 2000; Putnam, 2000; Thöni et al., 2012). However, studies connecting these two strands of literature, on both theoretical and quantitative-empirical levels, was mostly absent until recently (Aldrich, 2010, 2011, 2012a; Aldrich and Meyer, 2015). Scholars across disciplines have issued and repeated calls for detailed investigations into "quantitative assessments of social capital as applied to disasters"(Aldrich, 2012a; Chandra et al., 2010; Koh and Cadigan, 2008). In a way, this paper is a response to those calls. However, rather than simply providing additional proof of social capital's role in a post-disaster scenario, we attempt to fill in the gap in literature by answering the "how" question: that is, we provide an answer to the question "how does social capital enhance post-disaster resilience?". Expanding on Ostrom & Ahn's (2008) hypothesis, we present trust as the connector that establishes the causal link

between social capital and post-disaster collective action. In other words, we demonstrate that social capital increases trust among individuals, which, in times of crises such as natural disasters, can foster collective action activities. To do so, we take a quantitative approach with hopes of providing a more generalizable narrative to the otherwise rich but mostly qualitative literature connecting social capital and post-disaster resilience.

Analytical Framework

Elinor and Vincent Ostrom's approach can be described as one that aims "not so much at grand theory building but rather at specific problems of collective action, governance, and social dilemmas" (Aligica and Boettke, 2011). In that sense, all theories of collective action are context specific, and that a fuller understanding of collective action requires investigating into the broader institutional framework under which the theory itself is realized. Figure 1 provides an analytical framework that paves way for rest of the paper. The arrows that connect variables inside the box relate to pay-off functions in a cooperative game-theoretic framework[1], whereas institutional rules are the 'invisible forces' that shape these pay-off structures in the first place. Different structural and contextual variables can also influence each of these pieces in many ways, which are represented by variables outside the box.

[Insert Figure 1]

This analytical framework is based on institutional rules that allow for reciprocal norms to exist and operate in the realm of collective action. We postulate that, in communities governed by norms of reciprocity, social capital builds trust among members, which in turn increases the likelihood of participation in collective action. That is, the interconnectivity between members in

[1] Theoretical framework for collective action based on reciprocal norms is consigned to online appendix-1.

a community creates conditions such that mutual trust can be built and strengthened based on a common understanding of what constitutes socially laudable and/or reprehensive behaviors. It is through the incorporation of these norms into each individual's pay-off function that the classical Prisoner's Dilemma (PD) game of public-good provision is transformed into a game of assurance such that the possibility of a successful collective action emerges (see Fig. 2). It should be borne in mind, however, that under an alternate set of institutions characterized by restrictions on voluntary collective action and other congregations, these relationships may manifest differently. Our attempt here is not to theorize but to ground empirical analyses in institutional and contextual realities of post-earthquake rural Nepal.

[Insert Figure 2]

Data and Measures

Data Collection

The dataset employed for this study was collected by the lead author with support from the [institution name omitted for peer review purposes] and [institution name omitted].[2] The field survey took place in May-July 2017 in Sindhupalchowk, Nepal with the primary objectives of assessing household level impacts of the 2015 earthquakes and evaluating household responses to the quakes. The fact that Sindhupalchowk was the worst affected district with around 3440 casualties motivated our location choice for the study. The study period was carefully determined to allow for enough variation in household and community level coping responses as well as recovery processes. During the time of the field survey, most village towns and public infrastructures decimated by the earthquake had not been rebuilt, particularly in remote areas that were only accessible by feet. Wards 8 and 9, which represent the remotest villages included in

[2] The data collection was part of a research project titled "Determinants of household resilience against natural disaster shocks: pre-post and ex-post analyses of the 2015 earthquakes in Nepal." The project aimed at assessing the immediate household impacts of the 2015 Nepal earthquakes and investigating households' coping responses.

our analysis, were accessibly only after three to four hours of uphill hike from the closest bazaar with paved road. The lead author and enumerators spent two months in the earthquake devastated villages collecting quantitative data, listening to verbal testimonies, and reaching out to public authorities and village chiefs. The data collection was done using face-to-face interviews with representatives from households selected using stratified random sampling procedure. In each village (denoted in the dataset as wards), the sample size was proportional to the overall population size. The effective response rate was over 97%.

A brief overview of the study area (Summary Statistics)

We interviewed over 500 households in Basbari, Sindhupalchowk. At the time of the field study, Basbari had just been merged into the greater Melamchi municipality under the jurisdiction of the municipal government after having recently restructured as a separate Basbari Village Development Committee (VDC, i.e. a cluster of multiple village units under the administrative jurisdiction of a VDC chief/chairperson). There was a significant confusion among people (and surprisingly among local administrative officials) regarding the final administrative boundaries, as there were rumors about further restructuring. To avoid ambiguity, we retained the original (2011) administrative boundaries. Henceforth, wards will refer to the pre-2011 administrative boundaries.

Basbari comprises of nine wards, which represent the lowest level of administrative units in Nepal. Our respondents belong to diverse socioeconomic, ethnic and cultural backgrounds, with their shared earthquake experiences being the unifying characteristic. 55% of the respondents are female with an average age of 39 years; 83% are married; 34% live in non-nuclear family settings; 41% of our respondents have not receive any formal schooling, and 23% have only attained primary school (grades 1-5) level education. The majority of households (68%) engage

in agriculture as their primary occupation. Over 12% of Basbari residents belong to *Dalit* (lowest in the caste hierarchy) 40% belong to one of the *Janajati* (marginalized indigenous) groups. 71% are Hindus, and 27% are Buddhists (see Table 1). To put in perspective, our study area comprises of heterogeneous communities characterized by religious and ethnic (caste-based) cleavages in a rural setting in a developing country.

As a result of the 2015 earthquakes, roughly 12% of Basbari residents suffered from severe bodily harm (injury, death), whereas over 80% lost their homes and another 8.6% experienced some damages (Rayamajhee and Bohara, 2018). By the time of the field study, over 93% still suffered from emotional distress from the earthquake (ibid.). In a post-disaster context characterized by loss and distress, households still manage to participate overwhelmingly in collective action efforts. Figure 3 shows that 51.57% of Basbari residents actively engaged in post-disaster collective action efforts, with an astounding 24.02% reporting very high degrees of participation. This leads us to inquire into the underlying factors that motivate such high rates of collective action efforts.

[Insert Figure 3]

Variables for Empirical Estimation

Table 1 presents descriptive statistics for the sample of households.

a. Post-earthquake Collective Action

Each household representative was asked the following question: *Following the earthquake, how actively did you participate in disaster recovery/reconstruction projects?* To ensure that the respondent understood the question, each enumerator was trained and instructed to elaborate using tangible examples what such projects included: examples include rebuilding a local shrine, participating in community programs, and taking leadership efforts to rebuild schools and roads.

Responses were recorded on a likert-scale ranging from 'very inactive (1)' to 'very active(4).' The mean score was 2.43 and the standard deviation was 1.173.

b. *Trust*

A conceptual distinction between trust, trustworthiness, and reciprocity is apparent. We trust those who we deem to be trustworthy, as simple as that. In other words, trust refers to one's perception pertaining to the "reliability of others' dispositions and motivations" (Ferguson, 2013). As Ostrom and Ahn (2008) suggest, trustworthiness can be understood as a component of one's social capital endowment, whereas trust is a product of that endowment (p. 27). However, when we attempt to untangle these concepts empirically, most measures we employ to quantify them end up measuring similar or closely related concepts. In other words, the quantification of trust, trustworthiness, or reciprocity, at least in most observational settings, is prone to duplication and measurement errors.

To account for such operationalization issues and definitional ambiguities concerning trust, we use measurement model to 'distill out' trust. To do so, we employ three separate measures of trust: *a) Trust in people, b) Generalized Trust, and c) Reciprocal ties*. *Trust in people (T_1)* is a variable that captures one's ability to trust people in the village. T_1 can take three numerical values ranging from 1 (none) to 3 (high). *Generalized trust (T_2)* is a binary variable that takes on a value of 1 if the respondent thinks that "*Most people can be trusted*" and a value of 0 if s/he thinks that "*You can't be too careful in dealing with people*." Finally, *Reciprocal ties (T_3)* measures one's perception about the likelihood that friends and/or relatives will reciprocate financially in times of need. Like T_1, T_3 can take three values ranging from 1 (none) to 3 (high).

In other words, these three measures of trust (T_1, T_2, T_3) are used to estimate *Trust* (T^*), which therefore is a latent variable.

c. Social Capital

The task of pinning down the concept of social capital and/or quantifying it with precision is not an easy one. As many before us have highlighted, social capital, despite its powerful, intuitive appeal, "can take on many different forms," and is "fiendishly difficult to measure" (Dasgupta, 2000; Ostrom, 2000). However, despite these challenges, as Ostrom (2000) points out, there are "underlying similarities among all of the diverse forms" in that those who dedicate resources into "constructing patterns of relationships among humans are building assets whether consciously or unconsciously" (p. 178). This asset that relates to human connectivity is what social capital aims to encapsulate. For our empirical estimation, we use participation in community activities through formally registered membership-based and loosely organized groups. Based on several focus group interviews, we revised and expanded our original list to include all possible voluntary associations and divided them into 11 categories. Principle Component Analysis is conducted to reduce these potentially multicollinear categories into two orthogonal components each representing bonding and bridging/linking social capital[3]; the former pertains to bond across homogeneous, like-minded individuals within a community, whereas the latter relates to inter-group or across hierarchy links respectively (Storr and Haeffele-Balch, 2012; Woolcock, 2001).

d. Contextual variables and socioeconomic controls

While the temptation to craft a unified theory of human behavior is pervasive across social sciences, a recognition that individual behavior responds and adapts to contexts in which

[3] See Appendix-4.

interactions take place, and that it [individual behavior] is not simply a function of individual differences is crucial if we are to make any progress in understanding how individuals make decisions (Ostrom, 2010; Walker and Ostrom, 2009). The context of our study is one of an ethnically diverse, rural post-disaster setting in a developing country. To account for disaster impacts on households, we include two variables: *Health damage* and *Property damage*. Because subjective perceptions of similar future events influence one's collective behavior, we also include *Next EQ* variable. Many other structural variables are found to affect individual behavior in social dilemmas: size of the group, heterogeneity of participants, their dependence of the benefits received, among others (Aligica and Boettke, 2011). Admittedly, a detailed accounting of the institutional context encompassing cultural and historical considerations under which individuals make economic and political decisions is beyond the scope of a quantitative, empirical investigation. So, as Boettke (2018) frames it, for the purpose of analytical tractability, we simply take many of them as "part of the background conditions" (p. 944). Nonetheless, we acknowledge that these are crucial considerations, so we try to empirically account for them by including variables such as *Community size*, *Generations in Community* (i.e. how long the family has lived in the community is a proxy for historical roots), *Caste-Dalit* (traditionally marginalized caste treated as 'untouchables'), *Caste-Janajati* (traditionally marginalized, indigenous groups not categorized as 'untouchables'), and *Religion-Hindu* in our analyses. Additional controls include gender, age, marital status, education, and occupation. Further details on how these contextual and socioeconomic variables are coded, and their means and standard deviation values are presented in Table 1.

[Insert Table 1]

Empirical Estimation and Results

The Empirical Model

We take the analytical framework from the previous section and translate it into a general mixed (latent and observed) structural equation model (SEM) system. Structural equation models have been extensively used to formalize complex relationships involving latent and observed variables in econometrics (see e.g., Di Tommaso et. al., 2007; Krishnakumar, 2007), and development economics (see e.g., Ballon, 2018; Krishnakumar and Ballon, 2008), among other fields. The use of SEM serves our purpose in multiple ways: first, its illustrative simplicity allows us to consider all potential channels of influence into a single comprehensive system, second, it allows us to incorporate measurement model for trust within the same analytical structure, third, it allows us to evaluate both the mediated effects (through trust) as well as direct effects of social capital, and finally, it allows us to specify appropriate variance-covariance structure for the system of equations. While a reduced form equation may be a natural way to illustrative the causal channel, doing so will mask the underlying channels and complexities that are central to our narrative. The SEM system employed for our empirical analysis can be represented by the following multi-equation model:

STRUCTURAL EQUATION MODEL:

$$CA = \alpha_0 + \alpha_1 T^* + \alpha_2 SC_{bond} + \alpha_3 SC_{brid-link} + \alpha_4 CV_1 + \alpha_5 X_1 + \alpha_6 X_2 + \varepsilon_1$$

$$T^* = \beta_0 + \beta_1 SC_{bond} + \beta_2 SC_{brid-link} + \beta_3 Z_1 + \varepsilon_2$$

$$SC_{bond} = \delta_0 + \delta_1 X_1 + \delta_2 X_2 + \delta_3 X_3 + \delta_4 X_4 + \varepsilon_3$$

$$SC_{brid-link} = \gamma_0 + \gamma_1 X_1 + \gamma_2 X_2 + \gamma_3 X_3 + \gamma_4 X_4 + \varepsilon_4$$

Measurement Model for Trust:

$$T_1 = \phi_0 + \phi_1 T^* + \varepsilon_5,\ \phi_1 = 1$$

$$T_2 = \varphi_0 + \varphi_1 T^* + \varepsilon_6$$

$$T_3 = \theta_0 + \theta_1 T^* + \varepsilon_7$$

In the above set up, the relationships between post-disaster collective action (*CA*), trust (*T**), bonding social capital (SC_{bond}) and bridging/linking social capital ($SC_{brid-link}$) are represented by the first two equations. Equations 3 and 4 account for the endogenous processes that determine households' social capital endowment. The remaining equations 5-7 represent different measures of trust: *Trust in People* (T_1), *Generalized Trust* (T_2), and *Reciprocal Ties* (T_3). Because all variables of trust (T_1, T_2, T_3) can suffer from measurement issues, we model them as functions of the actual trust (*T**), which, as discussed in the previous section, is a latent variable. Note further that the coefficient for actual trust in equation 5 (ϕ_1) is normalized to 1 so that its magnitude is pegged against T_1. We assume block-independence between the two systems, i.e. equations 1-4 and 5-7. Moreover, we allow for contemporaneous correlation across trust (2), and bonding (3) and bridging/linking (4) social capital equations to account for potential interdependency and/or simultaneity. Doing so is vital to our analysis as there could be unobserved determinants of participation in community groups that could also influence levels of trust and vice versa. For robustness purposes, we test multiple variance-covariance structures to see if that impacts our findings in any way; they do not.[4] Rank and order condition are examined to ensure econometric identification.[5]

Results

[4] See Appendix Table A-5
[5] See Appendix-2.

Asserting causality using a SEM approach alone can trigger contentious debates (Mueller, 1999). Nonetheless, it [SEM] is a powerful tool to assess the accuracy of complicated causal relationships that are *a priori* identified in the literature (Toma et al., 2012). In that regard, we employ SEM not to ascertain causality but to test the validity of the conceptual framework for understanding collective action postulated by Ostrom and her co-authors (see Ostrom and Ahn, 2008; Walker and Ostrom, 2009) and further expanded and/or examined by social scientists in many post disaster scenarios (e.g. Aldrich, 2012; Chamlee-Wright and Storr, 2009; Storr and Haeffele-Balch, 2012). For internal validity purposes, we employ traditional econometric techniques using instrumental variables that are conventionally employed to make causal claims and compare them against the SEM models under different variance-covariance structures. Table 2 provides a comparison of results from OLS, two-stage least squares, and three-stage least square methods against those of the SEM approach. Coefficients remain robust to alternate modeling approaches. The statistical package (STATA) uses to generate estimates employs iterative generalized least squares (i-GLS) method for the two-stage and three-stage least squares methods, whereas maximum likelihood estimator (MLE) is used in the case of SEM. Notwithstanding differences in convergence approaches, our results across models 2-4 are near-identical. Compared to models 2-4, we find that OLS underestimates the role of trust and overestimates the role of social capital. Results from two- and three- stage approaches are identical because the model is exactly identified. The purpose of this exercise is to demonstrate that SEM is essentially equivalent to multi-stage regression methods (2-sls and 3-sls) under specific variance-covariance structures: under limited information assumption, SEM yields results equivalent to those of two-stage regressions, whereas under full-information assumption, it yields results equivalent to that of three-stage regressions. This is not to say that we are able to successfully establish causality, but that the same concerns with traditional instrumental variable

(IV) techniques, that is, those pertaining to the satisfaction of exclusion and relevance criteria of applied instruments (particularly weak instruments) and to the identification issues, are also prevalent in SEM approaches. However, SEM, with its added functionality of integrating measurement models within, enables us to account for measurement issues, which is one potential source of endogeneity. In that regard, our choice of SEM, especially considering its illustrative superiority over the 2SLS approach, is a sensible one.

[Insert Table 2]

[Insert Table 3]

Table 3 reports our main SEM results. Column 1 presents findings on the determinants of post-disaster collective action. An individual with high trust scores, that is, one whose subjective perception about the trustworthiness of his fellow-citizens, neighbors, and friends/relatives is high, is significantly more likely to participate in post-disaster collective action efforts. The coefficients for bonding and bridging/linking social capital indicate that participation in community-based organizations is significantly and positively associated with *CA* efforts. The mechanisms by which this can happen are many, which we shall delineate in the next section. As we discussed earlier, household decisions regarding participation in post-shock collective action (*CA*) are influenced by a host of factors, including socioeconomic, demographic, and contextual variables. We find that households in which members have suffered from major health damage as a result of the earthquake are less likely to participate in *CA* efforts. Moreover, one's expectations regarding future earthquakes also impact *CA* participation. We find that those who think that the next big catastrophe will occur much later in the future are encouraged to engage in such efforts. This is an intuitive finding in a sense that one might consider it futile to engage in any rebuilding or reconstruction projects if they think that the next big earthquake is impending. Results indicate that males are more likely than females to participate in post-disaster *CA*,

reflecting the patriarchal household dynamics in rural Nepal. The negative and significant coefficient for age reveals that younger cohorts are more likely to participate in post-disaster *CA* efforts.

On the other hand, participation in these community-based groups can enhance mutual trust among its membership, and can also help establish relationships with similar groups in other communities. This relationship is presented in Column 2. Interestingly, we find that, among the two categories of social capital included in the model, only bonding social capital (proxied by participation score in community-based user groups) have a significant (and positive) impact on trust. Because bonding social capital represents social ties among homogeneous individuals/groups, it can bring members with shared interests and background together and can amplify mutual trust. On the other hand, while bridging and/or linking social capital can bring people together for collective efforts (as described before), they do not necessarily build mutual trust. On the contrary, the negative sign (although not significant) of the coefficient indicate that participation in religious, civic, political affairs can be divisive. This is not surprising in the current context of globally ubiquitous political and religious polarization. In Nepal's national context, the decade long Maoist insurgency (1996 to 2006) and a series of political upheavals following the Comprehensive Peace Accord signed in November, 2006, testifies to that fact. Lastly, we find that past history of *Family Abandonment* within a family negatively influences trust.

Note that many of the factors that impact post-disaster collective action also influence individual participation in community-based organizations and/or groups (Columns 3 and 4). Furthermore, owing to Nepal's Hindu traditions and their influence on many aspects of social and political

lives, we take into account the impact that religion and caste can have in encouraging or precluding entry to many community-based organizations. For example, someone belonging to *Majhi* (Dalit) may face significant barriers if s/he attempts to join a forest user-group, since *Majhis* have been traditionally confined to fishing-related occupations, whereas a *Kami* (another Dalit caste) household, in some cases, may not be allowed to join water user group, because a Brahmin-dominated group may treat her/him as an untouchable; similarly, an adherent of *Kirat* faith may not be able to join a *Guthi-Samaj* (a religion-based welfare group). As suspected, results reveal that being a *Dalit* is a major barrier to entry for both user groups and civic/political groups. *Janajatis* on the other hand, do not face as dire levels of discrimination as do the Dalits. Note, however, that the coefficient signs for *Caste-Janajati* in columns 3 and 4 are negative, indicative of its negative (but not statistically significant) association with community group participation. The bottom heavy caste system in Nepal, with more pronounced and numerous sub-caste classifications towards of the bottom of the hierarchy leads to weak social capital towards the bottom at both intra- and inter- caste levels. This weaker social capital among ethnic minorities or marginalized groups is prevalent in other Asian countries[6]. On the other hand, *Hindus* have higher levels of bonding as well as bridging/linking social capital, reflecting the cultural and political dominance that they [Hindus] continue to enjoy, relative to non-Hindus, in the former Hindu kingdom of Nepal. Coefficients for other controls show that being a female is associated with lower levels of social capital (of both categories); Joint-family households, perhaps owing to their bigger family sizes, tend to have higher levels of bonding social capital, but this does not lead to higher levels of bridging/linking social capital; Households whose

[6] Arouri et al. (2015) observe a similar relationship in their disaster resilience study in Vietnam.

primary source of income is agriculture tend to have higher levels of participation in user groups; Educated households tend to have higher levels of social capital (both categories).

Columns 5, 6, and 7 show results from the measurement model. As discussed earlier, the coefficient for reciprocal ties (T_3) is pegged at 1. The significant (and positive) coefficients for *Trust* mean that the relationship between the latent variable and its measures is consistent and that the chosen indicator variables are relevant.

All of the these models are estimated using linear regressions with robust standard errors where the processes (equations) that predict trust and social capital are allowed to contemporaneously correlate. The path diagram for the specified SEM model (Table 3) is presented in Figure 4.

The Mediatory Role of Trust

Table 4 displays results from the mediation analysis. Following SEM estimation, we compute direct and mediated effects that the two categories of social capital have on post-disaster collective action[7]. Panel A presents direct and indirect effects of bonding social capital, whereas Panel B reports those of bridging/linking social capital. We find that bonding social capita has both direct and indirect (that is, mediated through trust) effects. Roughly 40% of the total effect that bonding social capital has on collective action is mediated through trust. In other words, trust explains 40% of the association between bonding social capital and collective action. This is crucial from a policy perspective, because any measures that aim at enhancing bonding social

[7] The adjacent flow-diagram helps us understand how these effects are calculated. Path A represents the causal effect of social capital (any type) on trust, path B links trust to collective action, and path C is the direct link between social capital and collective action. Indirect effect of the specific form of social capital occurs through paths A-B and is calculated as the product of these two effects (Direct effect=A*B). Total effect is the sum of direct (C) and indirect (A*B) effects, that is: Total effect=A*B+C.

capital but somehow ends up depleting mutual trust through misaligned incentives does disservice to the community. On the other hand, while bridging/linking social capital has direct effects on collective action, we find that no (significant) effect is mediated through trust in this case. In fact, the negative (but not significant) sign points to the opposite direction.

While this study does not delve into the innerworkings of the direct (non-mediated) impacts of social capital, many of these effects have been extensively investigated. Some of these effects occur through increased access to informal and social-resources (Beggs et al., 1996), social-learning (Storr et al., 2017), provision of club goods (Chamlee-Wright and Storr, 2009), increased solidarity and civicmindedness (Tatsuki, 2007), and so on.

[Insert Table 4]

Sensitivity Analysis

A number of robustness checks were implemented to evaluate the sensitivity of our results to alternate modeling approaches and specifications[8]. Our findings hold.

Discussion and implications

Our results underscore the central role that social capital plays in resolving collective action problems, which is critical for post-disaster recovery. Our findings that both a) strong ties among homogeneous members in a group (bonding social capital), and b) weak ties among heterogeneous groups or vertical ties across hierarchies (bridging and linking social capital) lead to higher levels of post-disaster collective action corroborate the claim by Nakagawa and Shaw (2004) that social capital is indeed the "missing link to disaster recovery." We provide further evidence that bonding social capital also has indirect effects, in that, it results in a higher degree

[8] Detailed description and results from robustness checks are provided in appendix-3.

of mutual trust among members in homogeneous groups, thereby increasing probabilities of cooperation for collective action. On the other hand, secondary findings reveal some disconcerting realities. Caste and religion are strong (negative) predictors of both bonding and bridging/linking social capital. This suggests that caste- and religion-based discrimination continue to preclude membership in community-based organizations. Even though Article 24 of the newly promulgated constitution of Nepal has established the *Right against Untouchability and Discrimination* (Const. of Nepal, 2015), constitutional guarantees alone are insufficient. Perhaps formal rules that reward inclusion in many facets of social life would be a step forward. Education also seems to positively impact social capital, so that nudges us to remain hopeful.

These results contribute to both theoretical and policy discussions. First, we shed light into the social dimension of human behavior that frequently interacts with, and occasionally even dominates, the strictly (economic) pay-off maximizing behavior. This further emphasizes Ostrom's (2010) point that "a more general theory of individual choice that recognizes the central role of trust in coping with social dilemmas" is needed. The theoretical challenge, however, is not to be misunderstood as one of developing an all-encompassing theory of human behavior, but rather one of fitting multiple configural approaches that enable researchers to investigate factors that "enhance or detract from the emergence and robustness of self-organized efforts within multilevel, polycentric systems" (p. 642). Only such theory or a cluster of non-contradictory, situational theories can satisfactorily reconcile the competitive, (economic) pay-off maximizing behavior in one setting with the cooperative, trust-building, social norm abiding, reflective behavior in a different setting (Ostrom, 2007). Such theoretical framework may take us a step closer towards explaining how a common individual acting solely on his rational will, when facing extraordinary post-disaster challenges, is often willing to subdue his/her strictly

atomistic volitions and 'cash-out' the accumulated social capital. In such situations, s/he not only trusts others, but yearns to become trustworthy. To that end, s/he chooses to extend benefit of the doubt to her/his neighbors and naturally elevates the sub-optimal social equilibrium to better optima.

Secondly, on the policy side, this paper provides a more cautionary message than a prescriptive one. By presenting a post-disaster scenario where individuals mobilize their social capital to build mutual trust among one another and participate in collective action, we provide an insight into the domain of human behavior that post-disaster public policies often fail to account for. The implication is rather straightforward: Any policy aimed at overcoming post-disaster challenges or regulating invidious activities should not hinder mutual trust, or tear down the social fabric that is in place. As shown by a recent laboratory based study, any externally imposed minimum standard rules that aim to promote cooperation, although prevent egregious trust violations, end up inhibiting trust formation and depleting levels of trust and reciprocity *irreversibly* (Rietz et al., 2018). Therefore, rather than introducing new rules directed at precluding "bad" behaviors in the aftermath of disasters, a prudent choice could be do let the community's social capital play out its process uninterruptedly.

Our findings should not be extrapolated to conclude that social capital alone can solve first and second order collective action problems. Resolutions of larger CAPs, including many post-disaster recovery challenges, require formal or informal institutions and organizations that, in many instances, bring in ideas, resources, policies, and methods from the outside without an adequate understanding of local environment and social conditions. This paper presents no arguments or evidence to suggest that such programs cannot reach their goals or are somehow

less effective. However, if the resolution of CAPs are to go hand in hand with the preservation and advancement of democratic values, norms of self-governance, and more importantly, sustainable development, our findings are important in that they unequivocally establish that enrichment of social capital and furtherance of local trust are necessary intermediaries to that end. Therefore, any institutions and organizations, that have, as parts of their mission the resolution of CAPs, should strengthen and mobilize existing social capital, and work locally towards building trust and reciprocal norms conducive to economic recovery.

Conclusion

Elinor Ostrom spent several decades resolutely seeking to answer the following question: What are the conditions under which individuals can organize as a collective unit to overcome CAPs associated with the use and preservation of common pool resources? At the heart of her design principles aimed at resolving CPR problems is the quest for a sustainable mechanism of honoring and enforcing commitments (Ferguson, 2013). Such mechanism is virtually impossible to create and maintain without the community's "ability to develop a shared sense of trust" among its members – that is, a sort of a mutual bond and shared understanding that transcends the economic (in its strictest sense) sphere (ibid.). As Ferguson (2013) puts it, "the group needs to develop sufficient social capital to create mutual trust, and thus render cooperative commitments credible" (p. 203). However, developing social capital is a rather elusive quest, especially when we think of it as a policy to be crafted and implemented; there is no *deus-ex-machina* solution to generating it [social capital]. In other words, context matters. A solution that works in one scenario in one community may inhibit resolution in a different scenario in a different community. So, we should be cautious about not transporting Ostrom's CPR findings into a natural disaster setting without a full consideration of the local institutional context. However,

one unequivocal message from her work that we can apply ubiquitously is this: wo/men are not perpetually locked into a prisoner's dilemma puzzle. They are able to come up with solutions to their problems in ways that often puzzle the most omniscient experts, if indeed they exist.

The objectives and findings of this paper are rather modest. Insofar as the metric is the formulation of an effective 'policy solution' to post-disaster recovery, we fail decisively. Instead, what we set forth to do is to illuminate one of the many possible mechanisms by which individuals in a post-disaster setting can come together to rebuild their families and communities. The domain that this paper explores can be categorized as one of institutional design, of 'continuous knowledge process,' where 'fallible but capable beings' incessantly engage in continuous learning and error-correcting processes at operational as well as collective-choice levels (Aligica and Boettke, 2011). It is within the scope of these interactions across different levels that social capital facilitates collective action by altering beliefs and expectations regarding trust and trustworthiness of other agents. If this is forgotten or ignored, our findings serve merely as distractions (p. 57). The paper also refrains from providing in bullet points the determinants of successful post-disaster collective action. In fact, we do not know whether or not these collective action efforts were successful. Success or failure of any post-disaster collective action efforts depends on an array of contextual factors, the determination of which is beyond the scope of this paper. By demonstrating that individuals can mobilize their social capital to build trust among one another and engage in mutually beneficial collective action efforts, we show that citizens, even in the direst and rugged corners of the world, can mobilize their networks for bettering their conditions. The presumption that "individuals cannot organize themselves and always need to be organized by external authorities," which was pervasive then and still remains

the dominant dogma influencing post-disaster policies in Nepal and elsewhere, is ill-informed and needs to be extinguished if enhancing disaster-resilience is the goal (Ostrom [1990], 2015).

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Table 1: Descriptive Statistics of Variables

VARIABLES	Description	Mean	S.D.
Dependent Variable			
Post-EQ Collective Action	Following the earthquake, how actively did you participate in disaster recovery/reconstruction projects? (1 very inactive,….4 very active)	2.431	(1.173)
Measures of Trust			
Trust in People	Level of trust among people in the village (1 none, 2 low, 3 high)	2.202	(0.718)
Generalized Trust	General view about people's trustworthiness (Equals 1 if trustworthy, 0 otherwise)	0.536	(0.499)
Reciprocal ties	Likelihood that friends/relatives will financially reciprocate in times of need (1 none, …3 high)	2.566	(0.695)
SOCIAL CAPITAL			
Bonding	Participation scores for Forest, Agricultural, Water groups	-3.49e-09	(1.361)
Bridging-linking	Participation scores for civic, political, religious and sports groups	-5.04e-09	(1.531)
CONTEXTUAL VARIABLES			
Community size	Size of the ward (1=small, … 3 large)	1.869	(0.815)
Generations in Community	Equals 1 if households have lived in the community for more than a generation, 0 otherwise.	0.839	(0.368)
Health damage from EQ	Equals 1 if household experienced major health injury/death, 0 otherwise	0.114	(0.318)
Property damage from EQ	Equals 1 if household experienced major property damage, 0 otherwise	0.788	(0.409)
Next EQ	In how many years do you think the next big earthquake will occur?	139.5	(272.0)
Family Abandonment	Equals 1 if incident(s) of abandonment in the family	.1294	(.3359)
CONTROL VARIABLES			
Female	Gender=1 if female, 0 if male	0.555	(0.497)
Age	Age of the respondent	39.75	(14.70)
Married	Marital Status=1 if married, 0 otherwise	0.839	(0.368)
Family type-Joint	Equals 1 if joint family	0.343	(.4752)
Education	Highest level of education attained (1-6)	2.308	(1.460)
Occupation-Agriculture	Equals 1 if the household head's occupation is agriculture	0.688	(0.464)
Caste-Dalit	Equals 1 if Dalit, 0 otherwise	0.127	(0.334)
Caste-Janajati	Equals 1 if Janajati, 0 otherwise	0.406	(0.492)
Religion-Hindu	Equals 1 if Hindu, 0 otherwise	0.714	(0.452)
Observations		510	

[1]Participation scores generated using Principle Component Analysis varimax rotation-Appendix 1

Table 2: Model Comparison

	Model 1	**Model 2**		**Model 3**		**Model 4**	
	OLS	2SLS		3SLS (Full-information)		SEM (Full-information)	
VARIABLES	**Collective Action**	First-stage **Trust in People (T_1)**	2nd-Stage **Collective Action**	First-stage **Trust in People (T_1)**	2nd-stage **Collective Action**	**Trust in People (T_1)**	**Collective Action**
Trust in People (T_1)	0.167**	-	0.854*	-	0.854*	-	0.854*
	(0.0682)		(0.452)		(0.452)		(0.452)
Bonding Social Capital	0.148***	0.0515**	0.108**	0.0515**	0.108**	0.0515**	0.108**
	(0.0397)	(0.0254)	(0.0502)	(0.0254)	(0.0502)	(0.0254)	(0.0502)
Bridging-Linking Social Capital	0.139***	0.0533**	0.108**	0.0533**	0.108**	0.0533**	0.108**
	(0.0355)	(0.0228)	(0.0434)	(0.0228)	(0.0434)	(0.0228)	(0.0434)
Family Abandon. (instrument)	-	-0.345***	-	-0.345***	-	-0.345***	-
		(0.0926)		(0.0926)		(0.0926)	
Contextual Variables	YES	YES	YES	YES	YES	YES	YES
Household demographics	YES	YES	YES	YES	YES	YES	YES
Socioeconomic factors	YES	YES	YES	YES	YES	YES	YES
Constant	2.648***	2.067***	1.252	2.067***	1.252	2.067***	1.252
	(0.409)	(0.247)	(1.009)	(0.247)	(1.009)	(0.247)	(1.009)
Observations	508	509	508	508	508	508	508
R-squared	0.206	0.096	0.043	0.098	0.043		

Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Full parameter estimates for Models 1-4 are provided in appendix Table 9.

Table 3: Structural Equation Model Results

VARIABLES	(1) Post-EQ Collective act.	(2) Trust§	(3) Bonding SC	(4) Bridg-Link SC	(5) Reciprocal ties	(6) Generalized trust	(7) Trust in people
Trust (T*)	0.775***	-	-	-	1	1.277***	3.057***
	(0.294)				(0)	(0.250)	(0.795)
SOCIAL CAPITAL							
Bonding (SC_{bond})	0.144***	0.129**	-	-	-	-	-
	(0.0394)	(0.0552)					
Bridging-Linking	0.136***	-0.0543	-	-	-	-	-
($SC_{brid-link}$)	(0.0347)	(0.0462)					
CONTEXTUAL VARIABLES (CV_1)							
Community size	-0.0118	-	-	-	-	-	-
	(0.0591)						
Generations in commty.	0.0249	-	-	-	-	-	-
	(0.138)						
Health damage from EQ	-0.243*	-	-	-	-	-	-
	(0.138)						
Propt. damage from EQ	0.0212	-	-	-	-	-	-
	(0.116)						
Next EQ (expected)	0.000448***	-	-	-	-	-	-
	(0.000155)						
Family Abandonment (Z_1)	-	-0.116***	-	-	-	-	-
		(0.0448)					
Household demographics (X_1)							
Female	-0.503***	-	-0.265**	-0.449***	-	-	-
	(0.112)		(0.118)	(0.148)			
Age	-0.0111***	-	0.00590	0.00150	-	-	-
	(0.00420)		(0.00512)	(0.00577)			
Married	-0.105	-	0.115	-0.0802	-	-	-
	(0.132)		(0.162)	(0.202)			
Family type-Joint	-0.0130	-	0.249**	0.00613	-	-	-
	(0.102)		(0.115)	(0.143)			
Socioeconomic factors (X_2)							
Education	0.0186	-	0.0869*	0.203***	-	-	-
	(0.0434)		(0.0503)	(0.0618)			
Occupation-Agri	0.161	-	0.226*	0.0892	-	-	-
	(0.106)		(0.116)	(0.133)			
Cultural/Religious factors							
Caste-Dalit (X_3)	-	-	-0.343*	-0.443**	-	-	-
			(0.188)	(0.176)			
Caste-Janajati (X_3)	-	-	-0.261	-0.0351	-	-	-
			(0.173)	(0.208)			
Religion-Hindu (X_4)	-	-	0.574***	0.580***	-	-	-
			(0.169)	(0.185)			
Constant	3.050***		-0.881*	-0.615	2.584***	0.554***	2.240***
	(0.384)		(0.455)	(0.528)	(0.0305)	(0.0241)	(0.0372)
Observations	506	506	506	506	506	506	506

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Equations (2), (3) and (4) are allowed to have contemporaneous correlation. §Trust is a latent variable measured by three indicator variables: reciprocal ties, generalized trust, subjective trust on people.

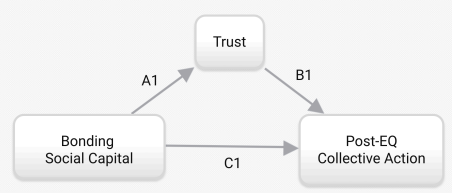
Table 4: Mediation Analysis

Panel A

Mediator Variable: Trust

Treatment Variable: Participation Score for Bonding Social Capital

Effect	**Coef.**	**Robust SE**
Average Causal Mediation Effect (A1*B1)	.0999**	(.0427)
Direct Effect (C1)	.1438***	(.0394)
Total Effect (A1*B1+C1)	.2438***	(.0576)
Percentage (%) of total effect mediated	40.97%	

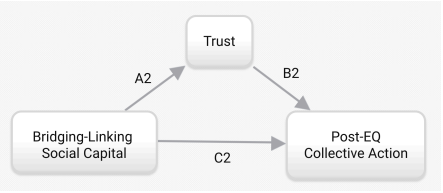


Panel B

Mediator Variable: Trust

Treatment Variable: Participation Score for Bridging-Linking Social Capital

Effect	**Coef.**	**Robust SE**
Average Causal Mediation Effect (A2*B2)	-.0421	(.0358)
Direct Effect (C2)	.1359***	(.0346)
Total Effect (A2*B2+C2)	.0938*	(.0491)
No statistically significant mediation effects		



Notes: Authors assume independent causal pathways to conduct mediation analyses.

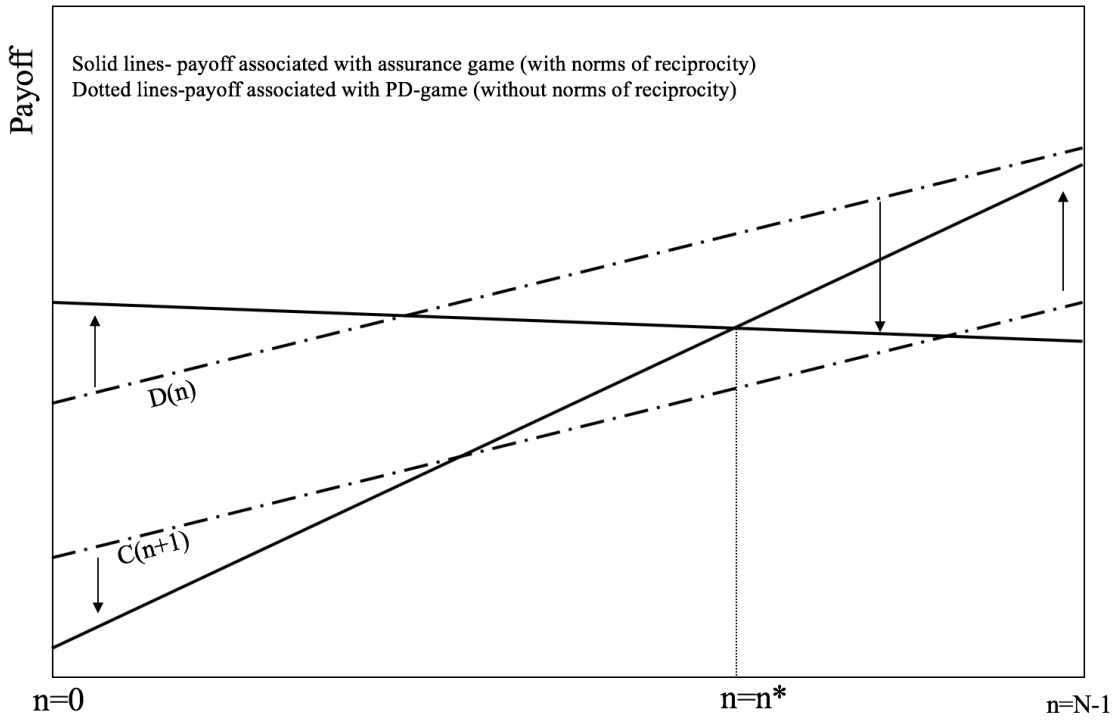


Figure 1: n-person Game of Collective Action

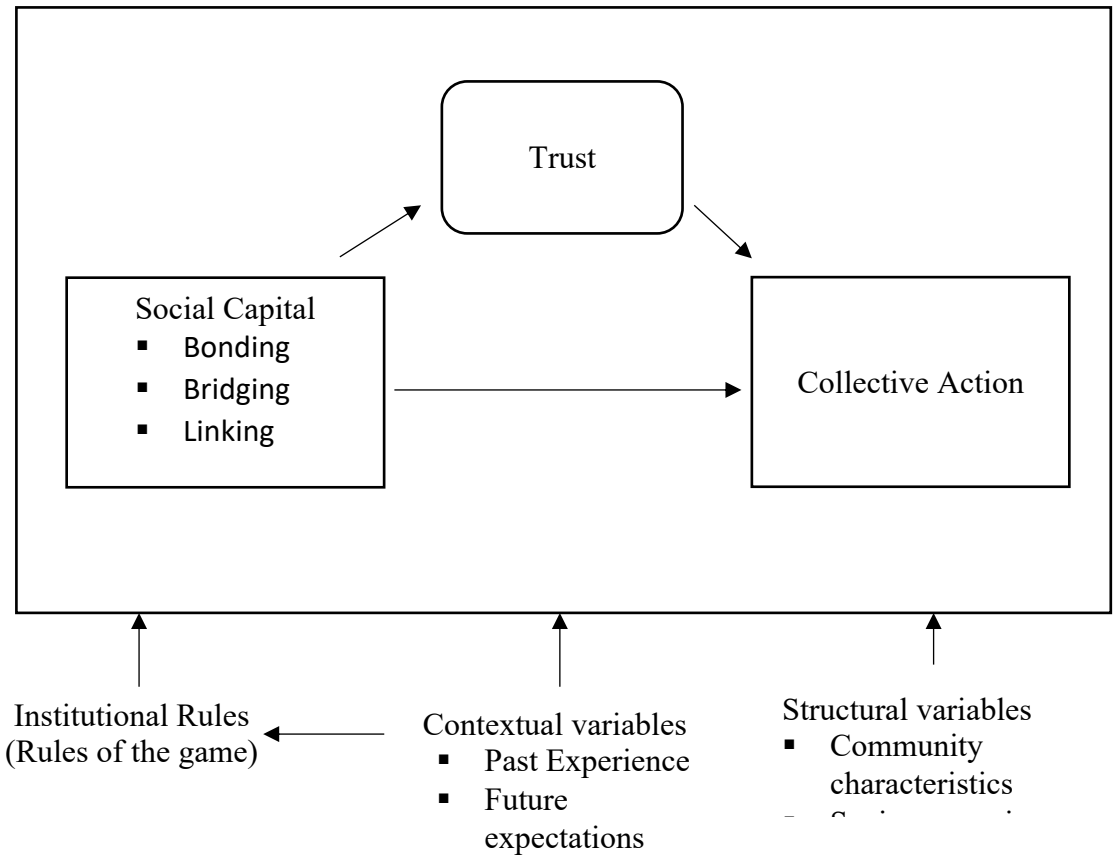


Figure 2: Analytical Framework based on authors' adaptation from Ostrom and Ahn (2008)

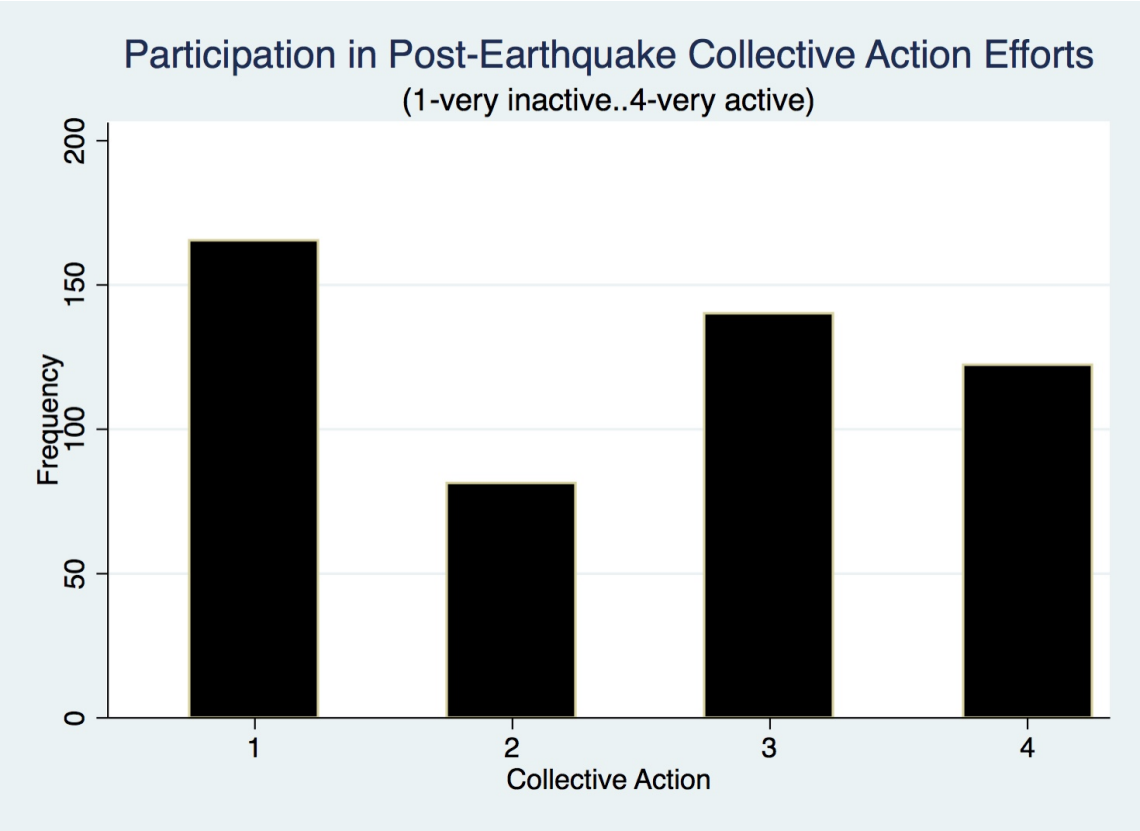


Figure 3: Levels of Collective Action Engagement

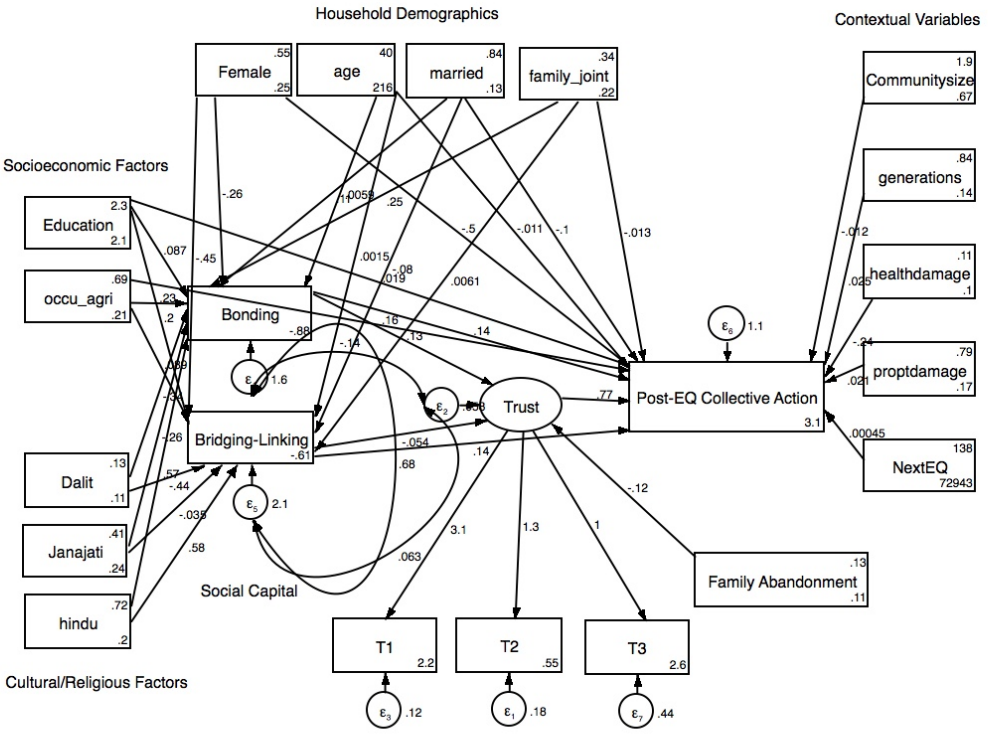


Figure 4: Path Diagram

APPENDIX

NOT FOR PUBLICATION IN PRINT

(may be published online, if applicable)

1. Theory of Reciprocal Norms and Collective Action

In Manebhanjyang, a rural village in Basbari, village elders are considering a post-earthquake collective action project involving the reconstruction of a local stupa (Buddhist shrine) that was damaged by the 2015 earthquakes. Our representative individual Pemba, who resides in Manebhanjyang, is contemplating whether or not to participate in the reconstruction project. We characterize Pemba, not based on strict rational egoist assumptions, but on characteristics consistent with norms of intrinsic reciprocity (Sobel, 2005). That is, his volitions and actions are subject to *the tribunal of the impartial spectator*, – to that of *the man within the breast*, – whose "jurisdiction is founded in the desire of praise-worthiness, and in the aversion to blame-worthiness" (Smith [1759] 1982, p. 130-131). His ill-actions, even when unnoticed by outside spectators, haunt him, and he is angered when someone deceives him. In both instances, he experiences a subtraction from his net utility (ψ), – by guilt in the first case and by anger in the second. Similarly, when his good actions are reciprocated by good actions from others, he feels a sense of approbation ("warm glow"); when he retaliates someone's bad action with a similar bad action unto them, he feels a sense of "getting even." In such cases, he experiences an increase in his overall utility (β).

To conceptualize this formally, we adopt a modified public-good game from Ferguson (2013) and retain his notations (p. 96). Pemba's utility (pay-off) function is given by:

$$(1)\ u_i = -c_i + \alpha \sum_{j=1}^{N} c_j + z_s\,\beta - z_o\psi.$$

In equation (1), c is the cost of contributing towards collective action, $\alpha < 1$ is the marginal product of c, N is the maximum number of eligible contributors in Manebhanjyang, $j=1,....N$, z_s is the proportion of players who take the same action as Pemba, and z_o is the proportion of those

who take the opposite strategy. Although a multitude of institutional arrangements can exist, independently or simultaneously, that produce a variety of pay-off structures[1], a non-overlapping institution characterized by a social norm (*SN*) arrangement with no material or social sanctions is adequate for out exposition. [2] [3] In this institutional arrangement, the interconnectivity between members in a community, that is, the community's intrinsic social capital, directly manifests through social norms (*SN*). In turn, *SN* shapes the payoff structure through β and ψ by determining what constitutes a socially laudable or reprehensible behavior. Incorporating $\beta > 0$ and $\psi > 0$ into the pay-off function changes the classical Prisoner's Dilemma (PD) game of public-good provision into an assurance game, such that a possibility of a successful collective action emerges. This is critical because models based on strict rational egoist assumptions that do not fully explain cooperation that occurs in many CAPs in the lab and field (Gächter, 2006; Ostrom, 2000). Again, following Ferguson (2013), we interpret the [joint] magnitude of β and ψ as reflecting mutual trust within an institutional framework of reciprocal norms.[4] We represent this by $\tau(p, t, SN) = \beta + \psi$ for simplicity, where mutual trust depends on the interplay between

[1] The institutional framework that our formal model is based upon is that of a [typical] social norm of the *A-D-I-C* structure which has a deontic (*D*) but no or-else (*O*) statement. For further details on the 'syntax' of institutions, refer to Crawford & Ostrom (1995).

[2] Ferguson defines *SN* as "mutually understood and expected behavioral regularity" that determines one's ethical worldview within the social domain (2013, p. 168). Bowles's (2009) definition is similar: *SN* are "ethical prescriptions governing actions towards others" (p. 97). Fehr and Gachter's (2000) experimental findings highlight the role of punishment in reducing incidences of free-riding, but we contend that social enforcement through explicit social or material sanction is not necessary for [social] normative prescriptions to effectively increase cooperation levels in post-disaster settings.

[3] Consideration of the underlying institutions under which the games of life are played and the pay-offs are attained is vital to developing a fuller understanding of collective action. As William Riker (1980) puts it, "we cannot study simply tastes and values, but must study institutions as well" (p. 444). Institutions shape motivations, behavior, and outcomes. Our choice of intrinsic reciprocity based *SN* reflects a specific social setting of a rural Nepali village as it pertains to post-disaster collective action. Many concurrent institutional rules with stronger deontic (*D*) and severe or-else (*O*) statements can co-exist in other facets of social life.

[4] As the number of repeated interactions increase, the magnitude of $|\beta + \psi|$ increase proportionately. This "common perception of relatively high values for β and ψ" has been characterized as reflecting mutual trust pertaining to others' motivations (Ferguson, 2013, p. 100).

one's personality, number of interactions, and the social norms that determine what constitutes propriety and impropriety.

With all the aforementioned considerations, we now proceed to a n-person game of assurance. Let *C(n+1)* and *D(n)* represent Pemba's payoff functions corresponding to strategies *C* (contribute to collective action) and *D* (do not contribute to collective action) respectively. When Pemba cooperates (i.e. *n+1* cooperators), we have:[5]

$$(2)\ C(n+1) = [(n+1)\alpha - 1]c + \frac{n}{N}\,\beta - \frac{(N-1-n)}{N}\psi;$$

$$(3)\ D(n) = n\alpha c + \frac{(N-1-n)}{N}\,\beta - \frac{n}{N}\psi.$$

Note that we replace z_s and z_o from (1) with $\frac{n}{N}$ and $\frac{(N-1-n)}{N}$ in equations (2) and (3) respectively. Also, it is assumed that the utility loss from anger and guilt are equal, and that utility gain from "getting even" (from both *C-C* and *D-D* strategies) are also equal. Figure 1 (in the manuscript) provides a graphical depiction of the n-person game represented by equations (2) and (3). Note that the dotted lines correspond to a PD-game (with no norms of reciprocity), whereas the solid lines are payoffs associated with an assurance game (with norms of reciprocity).

In a game of assurance like the one depicted in Figure 1, for any value of n<n*, where n* is the point where curves *C(n+1)* and *D(n)* intersect, each participant has an incentive to choose not to participate in collective action as *D(n)> C(n+1)*, which means that the only stable Nash equilibrium (s-NE) in this region is at *n=0*. Similarly, in the n>n* region where *C(n+1)> D(n)*,

[5] Social and material sanctions (*s*) can incorporated into the model through an addition of a sanction term (*s*) into equations (2) and (3) (For delineation on an expanded model with sanctions, refer to chapter 5 in Ferguson (2013)). The corresponding pay-off functions take the following forms:

$C(n+1) = [(n+1)\alpha - 1]c + \frac{n}{N}\,\beta - \frac{(N-1-n)}{N}(\psi - s) - s^2/\psi;$ $D(n) = n\alpha c + \frac{(N-1-n)}{N}\,\beta - \frac{n}{N}\psi - \frac{n}{N-n}s$

the choice to participate dominates that of shirking, so another stable Nash equilibrium emerges at *n=N*. There is a third equilibrium in the game: at the point where *n=n**. This is, however, a highly unstable equilibrium (u-NE) because one participant's decision to flip leads to a landslide-effect pushing the final outcome to one of the end-point equilibria. This u-NE occurs when *D(n)=C(n+1)*, and the corresponding solution for *n** is:

$$(4)\ n* = \frac{N[(1-\alpha)c+\tau(p,t,SN)]-\tau(p,t,SN)}{2\tau(p,t,SN)}$$

Equation (4) has several implications. First, an increase in the cost of participation (*c*) pushes *n** further right; that is, it shrinks the n>n* region making the choice to contribute (*C*) less appealing. Second, as group size (*N*) increases, cooperative outcome becomes increasingly difficult to attain. However, high levels of mutual trust $\tau(p,t,SN)$ results in opposite effects; $\tau(p,t,SN)$ increases the likelihood of cooperative outcome (that is, contribution towards collective action). Moreover, once *C(n+1)> D(n)* emerges, $\tau(p,t,SN)$ generates stability as its magnitude increases with repeated interaction (*t*)[6] (ibid., p.95).

2. Model Identification

Identification of structural equation models remains a major challenge that receives inadequate attention. Although structural modeling software provide identification tests, they simply rely on sample estimates of parameters (Bollen and Davis, 2009), which cannot sufficiently, at least not on theoretical grounds, establish identification. Because an unidentified model means that at least one parameter value is not unique, results can be misleading. In this section, we briefly discuss

[6] Repeated interactions increase the degree of familiarity among players, which in turns increases the level of mutual trust and reciprocity: $|\frac{\partial\tau(p*SN;t)}{\partial t}| > 0$.

order (necessary) and rank (both necessary and sufficient) conditions for the identification of our model.

Order Condition:

To satisfy the order condition in a model of M simultaneous questions, for each equation, the number of predetermined (exogeneous) variables excluded from the equation must be equal to or more than the number of endogenous variables minus one in that equation (Gujarati, 2009). That is: K-k $\geq$ m-1 must hold, where K and k are numbers of predetermined variables in the model and the specific equation under consideration respectively, and m is the number of endogenous variables in the given equation. Block-independence implies that we can evaluate the two sets (blocks) of equations separately. The first equation is exactly identified (K-k= 6-3, m-1=3), the second equation is overidentified (K-k=6-1, m-1=2), the third and fourth equations are overidentified (K-k=2, m-1=0). The second block comprising of the measurement part of the model only connects to the main SEM through equation 2 (T^*), which is overidentified. Each equation in the measurement model is exactly identified. The measurement model is equivalent to factor analysis, where the latent variable (T^*) captures the mutual variance or the extent to which the three indicators of trust (T_1, T_2, T_3) move together.

Rank Condition:

The order condition is necessary for identification, but the rank condition is both necessary and sufficient. To satisfy the rank condition in a model of M simultaneous equations (and M endogenous variables), each equation is identified if and only if one or more nonzero determinant of order (M-1) (M-1) can be constructed from the coefficients of the variables not included in that equation but included in other equations in the system (Gujarati, 2009), which is

in fact the case for our model. Below is a step-wise demonstration of the rank condition compliance.

Step 1: First, we list all endogenous variables in the first row of a matrix

Step 2: For each equation in the SEM, a row is designated. In the row, each cell corresponding to a variable that is included in the equation, we code a value of 1, and 0 is the variable is missing. We now have the following M *x* K matrix of 1s and 0s.

CA	T	SC_{bond}	$SC_{brid-link}$	CV	X_1	X_2	X_3	X_4	Z_1
1	1	1	1	1	1	1	0	0	0
0	1	1	1	0	0	0	0	0	1
0	0	1	0	0	1	1	1	1	0
0	0	0	1	0	1	1	1	1	0

Step 3: Now, to check the rank condition for each equation (say equation *i*), we take columns corresponding to 0 in the i^{th} row (for equation *i*), exclude the specific row (i^{th}), and write out the remainder as follows:

Equation 1:

X_3	X_4	Z_1
0	0	1
1	1	0
1	1	0

Equation 2:

CA	CV	X_1	X_2	X_3	X_4
1	1	1	1	0	0
0	0	1	1	1	1
0	0	1	1	1	1

Equation 3:

CA	T	$SC_{brid-link}$	CV	Z_1
1	1	1	1	0
0	1	1	0	1
0	0	1	0	0

Equation 4:

CA	T	SC_{bond}	CV	Z_1
1	1	1	1	0
0	1	1	0	1
0	0	1	0	0

Step 4: Finally, we check to see if any row/column is present with all elements 0. In our case, no such row or column exists, which means each equation (and therefore the system of equations) is identifiable.

3. Sensitivity Analysis

A number of robustness checks were implemented to evaluate the sensitivity of our results to modeling approaches. As discussed in the main paper with reference to Table 2, we begin with various modeling approaches including ordinary least squares, two-stage least squares, three-stage least squares methods. When endogeneity is ignored (in the case of OLS), we find that the effects of social capital is overestimated whereas that of trust is underestimated. Nonetheless, results remain consistent (in terms of signs and significance) throughout. However, compared to our model of choice (Model 4), these models fail to illustrate different paths of influence, which are crucial for our analysis. Full parameter estimates for two stage regression models are provided in Appendix-3 (Table 8). Note, however, that these models do not address potential measurement issues concerning trust, and that an observed variable *Trust in people* (T_1) is used instead of the latent variable *Trust** in Table 3.

Another set of robustness checks include running SEM models with different variance covariance structures presented in Table A-5. If we assume no contemporaneous correlation across equations (Model 1), we are essentially estimating OLS (which we discussed before). The selected model (Table 3) allows for the joint estimation of equations for trust, and bonding and bridging/linking social capital. In Table A-5, Model 2 presents results from SEM that only allows for the joint estimation of equations for trust and bonding social capital; Model 3 allows simultaneity across two equations for social capital; And, Model 4 allows contemporaneous correlation across equations (2) and (3), and (3) and (4). Note that in a variance-covariance matrix corresponding to 2 equations (with 3 different elements), 7 var-cov structures are possible. The number quickly balloons up when we a system of 4 equations with 10 different elements (a triangular 4x4 matrix). We present results from a selected list of var-cov arrangements based on where one could plausibly suspect simultaneity. Our results remain robust throughout.

[Insert Table A-5]

Because of the ordinal (categorical) nature of our outcome variable, a case can be made that generalized structural equation model (GSEM) would be a better modeling approach to accommodate this non-linearity. We provide GSEM results (Table A-6) as a robustness check to show that our results remain consistent regardless. Ultimately, we deem that SEM is a better alternative because it serves our purpose best without adding unnecessary interpretative complexities.

[Insert Table A-6]

Finally, we also re-ran model with and without different contextual variables. We find that results are robust to different model specifications.

Table A-5: SEM results with alternate variance-covariance structures for Robustness Checks

	Model 1 ($\sigma_{ij}=0\ \forall\ i\neq j$)		**Model 2** ($\sigma_{23}\neq 0$)		**Model 3** ($\sigma_{34}\neq 0$)		**Model 4** ($\sigma_{23}\neq 0;\ \sigma_{34}\neq 0$)	
VARIABLES	**Collective Action**	**Trust**	**Collective Action**	**Trust**	**Collective Action**	**Trust**	**Collective Action**	**Trust**
Trust	0.785***	-	0.775***	-	0.785***	-	0.774***	-
	(0.294)		(0.288)		(0.294)		(0.290)	
Bonding Social Capital	0.143***	0.0203**	0.143***	0.0786**	0.143***	0.0203**	0.144***	0.108**
	(0.0396)	(0.00973)	(0.0394)	(0.0345)	(0.0396)	(0.00973)	(0.0394)	(0.0451)
Bridging-Linking Social Capital	0.136***	0.0132*	0.136***	0.0108	0.136***	0.0132*	0.136***	-0.0195
	(0.0346)	(0.00748)	(0.0346)	(0.00741)	(0.0346)	(0.00748)	(0.0346)	(0.0165)
Family Abandonment (instrument)	-	-0.129***	-	-0.122***	-	-0.129***	-	-0.119***
		(0.0472)		(0.0458)		(0.0472)		(0.0451)
Log pseudo-likelihood	-13293.758		-13290.176		-13256.327		-13251.614	
Observations	506	506	506	506	506	506	506	506

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. All control variables from Table 3 are included in Models 1-4. Full parameter estimates available upon request.

Table A-6: GSEM Results

VARIABLES	(1) Collective Action	(2) Trust§	(3) Bonding SC	(4) Brid-Link SC	(5) Reciprocal ties	(6) Generalized trust	(7) Trust in People
Trust (T*)	1.655***	-	-	-	1	1.303***	3.044***
	(0.562)				(0)	(0.259)	(0.789)
SOCIAL CAPITAL							
Bonding	0.225***	0.0195**	-	-	-	-	-
	(0.0712)	(0.00955)					
Bridging-Linking	0.258***	0.0127*	-	-	-	-	-
	(0.0693)	(0.00741)					
CONTEXTUAL VARIABLES							
Community size	0.00818	-	-	-	-	-	-
	(0.107)						
Generations in commty.	0.0530	-	-	-	-	-	-
	(0.244)						
Health damage from EQ	-0.314	-	-	-	-	-	-
	(0.246)						
Propt. damage from EQ	0.0704	-	-	-	-	-	-
	(0.210)						
Next EQ (expected)	0.000682***	-	-	-	-	-	-
	(0.000248)						
Family Abandonment (Z_1)	-	-0.130***	-	-	-	-	-
		(0.0466)					
Household Demographics							
Female	-0.889***	-	-0.233*	-0.462***	-	-	-
	(0.211)		(0.124)	(0.144)			
Age	-0.0202**	-	0.00782	0.00101	-	-	-
	(0.00810)		(0.00520)	(0.00555)			
Married	-0.0876	-	0.174	-0.111	-	-	-
	(0.245)		(0.170)	(0.192)			
Family type-Joint	-0.0102	-	0.239*	-0.00371	-	-	-
	(0.186)		(0.125)	(0.144)			
Socioeconomic Factors							
Education	-0.00129	-	0.106**	0.199***	-	-	-
	(0.0799)		(0.0512)	(0.0617)			
Occupation-Agri	0.291	-	0.180	0.113	-	-	-
	(0.191)		(0.126)	(0.131)			
Cultural/Religious Factors							
Caste-Dalit	-	-	-0.349*	-0.429**	-	-	-
			(0.203)	(0.174)			
Caste-Janajati	-	-	-0.210	-0.0499	-	-	-
			(0.184)	(0.208)			
Religion-Hindu	-	-	0.624***	0.568***	-	-	-
			(0.171)	(0.184)			
Constant			-1.092**	-0.556	2.584***	0.560***	2.251***
			(0.441)	(0.507)	(0.0299)	(0.0229)	(0.0321)
Observations	509	509	509	509	509	509	509

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Equations (3) and (4) are allowed to have contemporaneous correlation. §Trust is a latent variable measured by three indicator variables: reciprocal ties, generalized trust, subjective trust on people. Cut-points for equation (1) are (all significant) are omitted for presentational simplicity.

4. Principal Component Analysis for Social Capital

The 11 categories of community organizations include resource user groups (agriculture, water, and forest groups), finance groups (microfinance and credit groups), awareness groups (women's, and health groups), youth groups (sports group), religious groups, civic groups, and political groups. It should be noted that many of these groups (e.g. health, sports, religious) were loosely organized and did not adhere to strict participatory and/or membership guidelines. The inclusion of such group addresses concerns that the standard measures of social capital "do not map onto the empirical realities" of the developing world (Serra, 2001), while also adhering to the established measures of social capital (e.g. Coleman, 1988; Putnam et al., 1993; Woolcock, 2001). Because participatory variables (dummies) are prone to multicollinearity issues, and including all 11 variables into a multi-equation system adds unwarranted complexities, we conduct principal component analysis (PCA) with varimax rotation to reduce variables to a few orthogonal components.

When we exclude all components with factor loadings less than 0.40, we find that the civic, political, religious, and sports groups loads into the first component, whereas agricultural, forest, and water user groups nicely load into the second component. The third component captures variation in microfinance, credit, and women's group. Note that members of the same user groups tend to belong to similar socio-economic, cultural, ethnic, and religious backgrounds. This bond across homogeneous, like-minded individuals within a community has been identified in the literature as "bonding" social capital (Storr and Haeffele-Balch, 2012; Woolcock, 2001). On the other hand, membership in civic and political groups often cross socio-economic, cultural, ethnic, and religious boundaries. Such memberships are not confined to a single

community or ward, and can link individuals across entirely different social and regional settings. For instance, a member of the local Nepali Congress village or district committee can/will act as a local representative in the national convention of the Nepali Congress party. This "linking" social capital can be crucial in crises as it can connect impoverished/rural districts to the prosperous/urban ones or aid in lobbying efforts for resources (Chamlee-Wright and Storr, 2011; Storr and Haeffele-Balch, 2012). Finally, membership in religious and sports groups, which are conditional upon shared interests and values, brings individuals across heterogeneous groups together. Case in point, the local soccer team from Manebhanjyang (ward 9) may frequently play against another team from Bahunepati-chowk (ward 4), but their ties are weak owing to their heterogeneous ethnic backgrounds. This type of bond can be understood as "bridging" social capital (Storr and Haeffele-Balch, 2012). Our PCA analysis shows that memberships in bridging and linking types have a significant overlap, and separating them would engender multicollinearity issues. Based on these considerations, we rename the first and second PCA components as *bridging/linking* and *bonding* social capital respectively. The third component pertains to financial access and not to social capital, so we exclude it from our empirical models. For robustness purposes, we also include it in all our analysis, but see no significant illustrative gains from doing so (coefficients are not significant and original results remain robust). PCA results are included in Appendix 1(Table 7).

Appendix 1 (Table A-7): Principal Component Analysis Results for Social Capital (Varimax rotation)

Variables	Component 1	Component 2	Component 3	Unexplained
Participation in:				
Microfinance group	--	--	0.5812	0.497
Agricultural user group	--	0.4332	--	0.4822
Forest user group	--	0.6583	--	0.2934
Water user group	--	0.5488	--	0.383
Women's group	--	--	0.5874	0.4327
Credit group	--	--	0.4459	0.5734
Civic group	0.4887	--	--	0.4271
Political group	0.4358	--	--	0.5092
Religious group	0.4101	--	--	0.525
Sports group	0.4842	--	--	0.5242
Health group	--	--	--	0.5504

Note: Empty cells (--) in the table denote factor loadings<0.4.

Appendix 5 (Table A-8) : Full Parameter Estimates for Models in Table 2

	MODEL 1	Model 2		Model 3		Model 4	
	OLS	2SLS		3SLS (Full-information)		SEM (Full-information)	
VARIABLES	**Collective Action**	First-stage **Trust in People (T_1)**	2nd-Stage **Collective Action**	First-stage **Trust in People (T_1)**	2nd-stage **Collective Action**	**Trust in People (T_1)**	**Collective Action**
Trust in People (T_1)	0.167**	-	0.854*	-	0.854*	-	0.854*
	(0.0682)		(0.452)		(0.452)		(0.452)
SOCIAL CAPITAL							
Bonding	0.148***	0.0515**	0.108**	0.0515**	0.108**	0.0515**	0.108**
	(0.0397)	(0.0254)	(0.0502)	(0.0254)	(0.0502)	(0.0254)	(0.0502)
Bridging-Linking	0.139***	0.0533**	0.108**	0.0533**	0.108**	0.0533**	0.108**
	(0.0355)	(0.0228)	(0.0434)	(0.0228)	(0.0434)	(0.0228)	(0.0434)
CONTEXTUAL VARIABLES							
Community size	-0.0116	-0.0361	0.0130	-0.0361	0.0130	-0.0361	0.0130
	(0.0593)	(0.0380)	(0.0661)	(0.0380)	(0.0661)	(0.0380)	(0.0661)
Generations in commty.	0.0227	0.0110	0.0324	0.0110	0.0324	0.0110	0.0324
	(0.145)	(0.0936)	(0.157)	(0.0936)	(0.157)	(0.0936)	(0.157)
Health damage from EQ	-0.244	-0.00483	-0.217	-0.00483	-0.217	-0.00483	-0.217
	(0.151)	(0.0971)	(0.164)	(0.0971)	(0.164)	(0.0971)	(0.164)
Propt. damage from EQ	0.0289	0.0120	0.0316	0.0120	0.0316	0.0120	0.0316
	(0.119)	(0.0764)	(0.129)	(0.0764)	(0.129)	(0.0764)	(0.129)
Next EQ (expected)	0.000478***	0.000364***	0.000204	0.000364***	0.000204	0.000364***	0.000204
	(0.000179)	(0.000114)	(0.000263)	(0.000114)	(0.000263)	(0.000114)	(0.000263)
Family Abandonment	-	-0.345***	-	-0.345***	-	-0.345***	-
		(0.0926)		(0.0926)		(0.0926)	
Household Demographics							
Female	-0.502***	0.0126	-0.511***	0.0126	-0.511***	0.0126	-0.511***
	(0.110)	(0.0708)	(0.119)	(0.0708)	(0.119)	(0.0708)	(0.119)
Age	-0.0110**	0.00182	-0.0125***	0.00182	-0.0125***	0.00182	-0.0125***
	(0.00428)	(0.00275)	(0.00473)	(0.00275)	(0.00473)	(0.00275)	(0.00473)
Married	-0.104	0.00664	-0.0985	0.00664	-0.0985	0.00664	-0.0985
	(0.134)	(0.0864)	(0.146)	(0.0864)	(0.146)	(0.0864)	(0.146)
Family type-joint	0.00243	0.0931	-0.0744	0.0931	-0.0744	0.0931	-0.0744
	(0.105)	(0.0672)	(0.124)	(0.0672)	(0.124)	(0.0672)	(0.124)
Socioeconomic factors							
Education	0.0174	-0.00686	0.0216	-0.00686	0.0216	-0.00686	0.0216
	(0.0425)	(0.0273)	(0.0461)	(0.0273)	(0.0461)	(0.0273)	(0.0461)
Occupation-Agri	0.171	0.107	0.0852	0.107	0.0852	0.107	0.0852
	(0.106)	(0.0683)	(0.128)	(0.0683)	(0.128)	(0.0683)	(0.128)
Constant	2.648***	2.067***	1.252	2.067***	1.252	2.067***	1.252
	(0.409)	(0.247)	(1.009)	(0.247)	(1.009)	(0.247)	(1.009)

Observations	508	509	508	508	508	508	508
R-squared	0.206	0.096	0.043	0.098	0.043		

Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

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