Patterns of Interorganizational Collaboration in the Context of Emergency Preparedness

Simon A. Andrew
Kyujin Jung
Sudha Arlikatti

Department of Public Administration
University of North Texas

Abstract

According to the Institutional Collective Action framework, interorganizational collaboration can be described as a process where local governments and organizations voluntarily coordinate and cooperate in the production and provision of jointed activities. But their actions are often constrained by the cost of collaboration (Feiock 2013). While much has been written about the nature of collaboration, few have examined the patterns of collaboration in the context of emergency preparedness. Based on the Institutional Collective Action framework, we develop two hypotheses to test for bonding and bridging effects. While the bonding effect argues that local actors prefer to develop interorganizational ties that are clustered through their preference for certain partners in accomplishing joint activities, the bridging effect posits that actors take advantage of shared network resources by forging a tie with organizations that play a brokerage role. We conducted our study in the Southeastern Economic Region of the Korean Peninsular. Based on interorganizational ties among 170 organizations, we found support for the bonding effect. The analysis for the Exponential Random Graph Model (ERGM) was performed using SIENA *P**. The result suggests that, at least in the realm of emergency preparedness, local organizations are likely to establish interorganizational collaboration through a closely-knitted network structure. On the other hand, the negative estimates on the bridging effect demonstrate that local organizations are less likely to develop linkages with those that play a brokerage role. The results suggest the pattern of interorganizational collaboration in South Korea tend to be based on a closely-knitted structure. They also tend to establish collaboration with organizations with similar regional characteristics (i.e., metropolitan area and coastal region).

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Introduction

While bureaucracies are mostly driven by a clear set of rules and authorities, scholars in the field of public administration generally believe members actively involved in collaboration are driven by a common mission aimed at increasing public value (Agranoff and McGuire 2003; Rethemeyer 2005; Bryson, Crosby, and Stone 2006). The current literature assumes interorganizational collaboration can be managed like an organization (McGuire 2006). Which is to say non-governmental organizations and public agencies from various levels of governments have the capacity to voluntarily coordinate and develop an organizational structure similar to a formal organization. Bearing this in mind, collaborative efforts require stakeholders to establish operational rules in order to activate an agreed upon set of common objectives; set up formal or informal social mechanisms to coordinate activities of partners and accomplish tasks on behalf of the collective; and formulate distinctive organizational routines, roles, norms, and values (Agranoff 2006; McGuire 2006; McGuire and Silvia 2010).

However, in the area of emergency management, few have explored the factors contributing to the formation of interorganizational collaboration. This is unfortunate because the logic for advocating collaboration is that hierarchies are often inefficient at solving complex managerial problems. In its place, a collaborative arrangement, formal and informal, emerge to take advantage of both the flexibility of interorganizational relations, and the predictability of a hierarchical structure (Powell, Koput, and Smith-Doerr 1996; Feiock and Scholz 2010). This paper aims to fill this gap by examining interorganizational collaboration using social networks analysis and testing for bonding

and bridging effects among local response agencies. The main objective is to examine patterns of interorganizational collaboration in a disaster context.

In the following sections, we examine the literature on interorganizational collaboration. We highlight the barriers that explain the reluctance of public agencies in coming together and entering into interorganizational collaborations during emergency response. Based on the Institutional Collective Action framework, we develop two hypotheses to test for bonding and bridging effects. While the bonding effect argues that local actors prefer to develop interorganizational ties that are clustered through their preference for certain partners in accomplishing joint activities, the bridging effect posits that actors take advantage of shared network resources by forging a tie with organizations that play a brokerage role. The data collection section explains the methodology adopted for collecting data in South Korea and the analytical procedures for testing the hypotheses. The analysis found support for the bonding effect in explaining the patterns of interorganizational collaboration in South Korea. The paper is concluded with suggestions for future research.

Interorganizational Ties

Recent work examining the pattern of collaboration has been done in term of interorganizational ties--because they provide informal mechanisms for organizations to mitigate the costs of cooperation and coordination (Berardo and Scholz, 2010; Lee, Lee, and Feiock 2012; Andrew and Carr 2013; Andrew et al. forthcoming). In a study on the timing of evacuation behavior, for example, Aguirre, Wenger, and Vigo (1998) found that preexisting social relationships among responders had an impact on helping to reduce

time taken by citizens to evacuate to safety. A similar conclusion was reached by Kapucu and Van Wart (2006) in their analysis of emerging roles during 9/11 response operations, emphasizing the importance of preexisting relationships. There is also evidence to suggest patterns of intergovernmental collaboration evolve over time to minimize collaborative risks associated with uncertainty (Feiock, 2013). Andrew (2010), for example, argues that the presence of collaboration can be characterized by configurations of locally developed bilateral or multilateral arrangements to solving "regional" problems stemming from fragmented jurisdictional authority.

The presence of organizational ties is also important in providing valuable exchanges across organization, i.e., similar to what Thompson and Hawkes (1962: 275) labeled as "the synthetic organization." That is, an organization emerges because of organizational interdependency where a central node plays an important role during emergency response. While the arrangements highlight the need for organizations to come together and resolve their common concerns, their localized activities highlight how the different arrangements, formal or informal, shape and define interactions between local governments. It influences the ability of an organization to adapt because meaningful exchange of information and resources produce greater strategic options and innovative ways to respond to disaster needs (Kapucu, 2008; Kendra and Wachtendorf, 2003).

However, according to the Institutional Collective Action (ICA) framework, the outcome of collaboration is not easily achieved without some forms of compromise (Feiock 2009; Feiock and Scholz 2010). While the diversity of opinions encourages multiple perspectives to problem solving, conflict can arise because of differences in

organizational cultures (Toulmin *et al*. 1989). The barriers to interorganizational collaboration can be found in practice when delegation disrupts the balance of authority across different levels of government. Organizational culture and bargaining over administrative responsibilities can also severely restrict independent units from developing meaningful inter-agency interactions, crucial for regional coordination (Feiock 2009; 2013).

In the area of emergency management, the collective action problem is particular acute. For example, an emergency management structure can be described as "a doubled-edge sword" (Andrew and Kendra 2012). On the one hand, the fragmented bureaucratic structure may not cope well with the problems of interdependency and adaptability; on the other hand, local agencies still require a higher level of organization to internalize costs of coordinating multiple preferences and decision externalities. Edwards and Goodrich (2007) note that ideally the administrative functions in emergency management require managers to develop a comprehensive risk analysis, which becomes the basis for emergency planning. Yet, when an emergency situation arises, unexpected conditions often require local agencies to deal with unfamiliar issues beyond their expertise and capacity. Under this situation, the emergency response phase, frequently involves outside experts who may be unfamiliar with local contexts, which, in turn, may challenge the existing response procedures.

Another collective action dilemma is related to communication and coordination costs. A study conducted by Choi and Brower (2006) in a Florida county, for example, suggests that the effectiveness of a centralized network structure depends on the "relative completeness and accuracy of information" (2006, 668). When emergency managers

have a clear picture of their networks, they are likely to gain reliable information that can be passed through the hierarchical structure. Although such a network can enhance the efficiency of emergency response, the success depends on the adaptability of individual organizations in contributing to collective decision making. According to Andrew *et al*. (forthcoming), "Even small logistical problems can overwhelm organizational capacity during the disaster response phase. These can range from the unavailability of skilled personnel to repair damaged utilities, to handling and distributing disaster kits, to the feasibility of transportation networks to meet the needs of a large population, to the coordination of risk communication and warning channels. The feasibility of getting resources to other organizations, without prior planning, can also compound interorganizational friction and miscommunication."

While local governments can always establish mutual aid agreements with other local governments before a disaster strikes, the implementation of emergency response functions may be complicated by low political salience and fragmented governance structure (Sylves 2008; Andrew 2009, 2010). Another complication can be found when local emergency planning, mitigation, and preparedness developed by one jurisdiction are not consistent with a neighboring jurisdiction's policy preferences. In this situation, it is likely the neighboring jurisdiction will not have an incentive to invest resources in building capacity to cope with disasters. Subsequently, the ability of local governments to collaborate in emergency planning activities is likely to influence the way emergency response needs are dealt with during disasters.

Bonding Effects

One pattern is when local governments establish collaboration through formal agreements with multiple types of organizations clustered across political jurisdictional boundaries. Emergency management practitioners and scholars have long argued that emergency response is "localized regionally" (Sylves 2008). But, the localized patterns of regional coordination need not be based on a single arrangement but rather, could overlap across a range of implemented activities and planning processes. Because local units are often formed for administrative purposes, a highly clustered pattern of joint activities suggests that close working relationships exist among these jurisdictions. It also highlights how localities reap the advantages of economies of scale, pool redundant resources together, and are poised to spread the risk in the presence of overwhelming response. An agreement consisting of multiple actors forming an ad hoc regional response organization is an example of localized regionalism (Andrew and Hawkins 2013).

The *bonding effect* posits that the pattern of interorganizational ties develops when arrangements are clustered around a few large jurisdictions suggesting the preference for certain partners in joint activities. For instance, if two agencies come together voluntarily and establish formal and informal agreements to coordinate local activities, and other organizations establish arrangements with either one of these agencies, they collectively constitute a clustered-network of interorganizational linkages forming a region-wide network structure. The densely connected ties at the core of the network structure, implies a cohesive structure. These relationships can develop through what Moynihan (2008) describes as a "crisis learning" where a network of emergency

responders learn how to respond to a disaster under conditions of uncertainty. They may do so through the socialization process, where norms of reciprocity are internalized.

> **H1**: An organization is likely to establish interorganizational ties with those who are directly linked with each others.

Bridging Effects

Alternatively, where limited or no disaster preparedness and joint planning efforts exist, local capacities may be overwhelmed when a disaster strikes. This would call for a centralized, more powerful organization to step in and help with disaster response management. The *bridging* hypothesis is thus generally critical about the potential benefits generated by a densely-knitted network structure. According to Andrew et al. (forthcoming), "extending the argument presented by Weil *et al*. (2011), in a situation where resources are scarce, having a closely-knitted network means members of the network would expect resources to be shared and various forms of supports provided amongst each other to keep them afloat. Assuming organizations actively involved in providing support to their community during disaster response are inherently capable of withstanding external disruptions, being close to weaker organizations in a network would impose a greater burden of sharing and responsibility on their functioning." The bonding effect would thus undermine organizational capacity and overwhelm internal resources.

Interorganizational ties developed by a diverse set of independent organizations with a few central hubs are highly probable to overcome the costs of coordination. Being

in the central position suggests the organization has the capacity to take on the responsibilities of allocating the flow of resources. Such set of ties can also provide the organization with accessibility to a wide range of additional resources by strategically collaborating with others in the network. Moreover, the organization can pool novel resources from various sources and thus spreading the risk of organizational failures. The bridging effect also posits that in a centralized structure, an organization acting as the central actor has status and prestige. While some organizations may have prestige and status by virtue of their authority, others gain social recognition through the availability of resources and specialized skills of their units. Therefore, an organization is motivated to establish ties with a central actor because of its status or prestige. The states signals behavioral expectations that guide organizations' interactions and provides the incentives for others to pursue linkages with organizations that play a brokerage role. This line of reasoning leads us to our next hypothesis that,

> **H2**: An organization is likely to establish interorganizational ties with those who play a brokerage role.

Homophily Effects

In the field of emergency management, the *homophily effects* allow us to investigate diverse environmental features of organizations that have a significant effect on their patterns to collaborate with others across the sector. Homophily effects posit that similarities of actors within interorganizational networks will predispose the actors to have comparable policy preferences and strategic behaviors to reduce transaction costs

(Goodreau *et al*. 2009). In terms of collaboration across the sector, Lubell (2007) notes that intrinsic similarities of organizations are particularly crucial for selecting partners to collaborate with. This is important to reducing transaction costs (Feiock and Scholz 2010) or minimizing risks derived from interorganizational collaboration (Gulati and Gargiulo 1999). This leads to organizations simultaneously considering the best candidates who possess applicable information and resources that they lack and/or can adopt. Although some organizations may belong to different sectors (e.g., public and nongovernmental sector), they may be located at the same coastal line, for instance, and forge ties each with each other across the sector, rather than others without locational similarities. Since similar environmental characteristics may result in similar hazard risks, the organizations may collaborate with those who have similar preferences for usable resources and information to mitigate hazards and to respond to the disasters. Therefore, we hypothesize that

> **H3**: An organization is likely to establish interorganizational ties with similar others.

Research Design And Data

The empirical study was conducted in South Korea. The empirical study aims to examine, in the area of emergency preparedness, the pattern of interorganizational collaboration in South Korea? Currently in South Korea, the National Emergency Management Agency (NEMA) is the main agency responsible for developing and coordinating a comprehensive emergency management system. Established in 2004,

NEMA is authorized by the Basic Act on Emergency and Safety Management (2004) to implement and develop a national emergency management system that is comprehensive, risk-based, and adopts an all-hazards approach.

However, the national emergency management system has been criticized on several grounds. For example, according to Ha and Park (2012), public agencies at the national level are assumed to play the leading role and provide directives to lower level governments, without paying heed to local preferences. They pay more attention to emergency response rather than mitigation and preparedness. According to Kim and Lee (1998), the national government is only ready to act when disasters are caused by human errors or technological hazards rather than natural disasters. The national legislations and public programs also tend to focus on vertical networks rather than horizontal relations. Thus, little is done to encourage interorganizational collaboration across non-governmental, business, and local community-based organizations (Ryu and Ahn 2007; Yang 2010).

At the regional level, the pattern of interorganizational collaboration, arguably, had been influenced much by the country's bureaucratic norms and structure. At the provincial level, for example, regional governments tend to function as an intermediary role between the national and local governments. The intermediary function not only provided necessary information from localities to NEMA for assistance and emergency aids, but also to certify local emergency operations plans. The plans must be consistent with the provincial government's emergency operations plan[1]. During disaster response,

[1] The emergency operation plan for local level governments typically a short-term plan, which requires annual revisions and update (BPNSM). The metropolitan and provincial governments, as specified by the Central Emergency and Safety Operations Headquarter (CESOP), are a five-year plan on each stage of emergency management: prevention, mitigation, response, and recovery (NEMA 2011).

the emergency operations headquarter at the provincial level would coordinate activities between the Central Emergency and Safety Operations Headquarter (CESOP) and localities' emergency operations centers. The provincial government[2] would also coordinate joint response when local governments are overwhelmed by disaster response and, within their respective jurisdictions, could provide directives to local governments.

There are evidence of interorganizational collaboration at the municipal level. The administrative responsibilities in emergency response are supplemented by local efforts, i.e., formal agreements are established across provincial or metropolitan political boundaries. For example, a bilateral agreement was established in August 2012 between Gangseo City in Busan metropolitan area and Geoje City. The formal agreement was on the development of preparedness and response plans related to emergencies on Geoga-Busan's bridge-tunnel fixed links. Such an agreement was not uncommon in the south east region of the Korean peninsula. Take another example: a bilateral agreement between Yangsan (city) and the Busan Meteorological Agency concluded in April 2008 with a joint meteorological observation agreement. A multilateral agreement has also been established between municipal governments. On August 2010, for example, an agreement was formed between 14 local governments in Busan metropolitan area and the South Kyeongsang province concerning emergencies related to floods caused by Nakdong River. In the area of emergency management, local governments also established agreements with non-governmental organizations such as Busan Volunteers Center and the regional branch of an NGO Living Good Movement in Busan.

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[2] According to Article 60 under the BAESM (2004), the provincial governor can request from CESOP to declare the region as a "special emergency district" in order to receive emergency aid.

The nature of interorganizational collaboration is also consistent with the observations in the field. For example, since the introduction of the Local Autonomy Act (1990/1994/1995/1989) and the Local Finance Act (1988) as well as the passage of the Devolution Promotion Act in 1999, there have been a growing number of NGOs established at the local level (Choi and Wright, 2004)[3]. Although the national government still plays an important role in guiding local affairs, as local autonomy expands to include public programs and services, local governments are increasingly coordinating services with community-based organizations and NGOs (Choi and Wright, 2004). An increasing importance of locality-NGO relations has been documented elsewhere. But, more importantly, according to Bae and Kim (2012) and Choi and Wright (2004), the concern for civil society has actually mobilized local leaders and communities to self-organized and pursuit a greater local autonomy.

The next section aims to examine the pattern of emergency management practices in South Korea. Although collaboration can enhance the likelihood and scope of regional integration, the patterns of interorganizational collaboration in South Korea is still understudied.

Research Site

In order to understand patterns of interorganizational collaboration in South Korea, data collection was conducted in the southeastern region of the Korean Peninsula. The Southeastern Economic Region (SER), comprised of Busan and Ulsan Metropolitan areas

[3] Jones and Yokoyama (2005) argued that the formation of voluntary association is relatively low in South Korea, i.e., about 60 in 2005. The voluntary organization has to be registered with MOGAHA. They argued that the Local Autonomy Act and the intergovernmental transfer system create disincentive for the formation of voluntary associations. Moreover, some local governments in Korea are too small to reap the benefits of economics of scale and scope in the provision and production of the local public services.

and South Kyeongsang Province. The region is the most important industrial region in South Korea as well as the strategic foothold of the national economy. The total population of the SER is approximately 7.94 million, and the Gross Region Domestic Product (GRDP) reaches to about US$ 200 billion (MOPAS 2012). The Busan and Ulsan metropolitan areas have focused on the manufacturing industry such as automobile and marine plant factories. About 22 percent of the national industrial clusters are located in the SER, and global enterprises such as Samsung, LG, Hyundai, and Kia have their factories here (Jung and Jeong 2010). Recently, the SER has extended its economic outreach by partnering with Asian countries by collaborating with global cities such as Shanghai in China and Hukuoka in Japan (Yonhap News 2012). These efforts towards regional economic development have motivated regional stakeholders to build intergovernmental collaborations.

However, the geographical location of the region is vulnerable to natural disasters (i.e., typhoons, floods, and severe wild fires). According to NEMA (2011b), the damages from natural disasters, particularly typhoons have led to storm water overflows in the lowlands of SER resulting in an estimated US$ 4 billion in economic losses (i.e., 23.7 percent of the total losses to South Korea) in the last decade from 2001 to 2010.

The region is also highly fragmented. For example, regional governments often take on the role of coordinating body during emergency recovery processes. Yet, they are not responsible for establishing short-term planning strategies to mitigate hazards related to natural disasters (NEMA 2011a; MOPAS 2012). The Local Safety

Management Committee (LSMC)[4] coordinates local organizations to transmit information and resources by directly communicating with MOPAS and NEMA. Also, the LSMC is only responsible for mapping disaster vulnerability and managing local emergency management fund. The regional headquarters of fire and police administration often perform their duties independently of regional governments and have separate communication channels with local branches[5].

Sample Selection

Data collection was conducted in two stage. During the first stage, a snowballing sampling method was employed to identify key organizations involved in emergency management activities in the southeastern economic region of South Korea. Before administering the survey instrument, a pilot test was conducted on 20 public organizations (i.e., 5 cases in each Busan and Ulsan metropolitan areas and 10 cases in the South Kyeongsang province). At the initial stage, only 43 local governments were contacted between July 16 and 28, 2012, who then identified up to three other organizations they frequently communicated with during emergency response. The process produced a total of 170 organizations, which included national, provincial, and local agencies and nongovernmental organizations. Although considerable efforts were made to solicit response from regional and national level agencies, none agreed to

[4] The activities of the Local Safety Management Committee (LSMC) are organized by the city mayor who works with the directors of local fire and police stations, local branches of public agencies (e.g., Korea Electric Power Corporation and Korea Telecom), and nongovernmental organizations.

[5] Local fire and police stations as well as nongovernmental organizations (e.g., local homeland reserve associations and emergency medical service organizations) work jointly with local governments to coordinate activities of local emergency management networks (NEMA 2011a).

complete the survey. They were included in the final networks analysis because they were referred by those who completed the first and second surveys.

The second stage of data collection was based on a structured survey (phone survey), which was sent to 170 organizations in August 10, 2012 (i.e., after the snowballing sampling procedure). The response rate was 76.4 percent (i.e., 130 organizations). Interviews were conducted over the phone and included senior public officials from municipal governments, assistant chief of fire and police stations, and non-governmental organizations. More specifically, about 33 percent of the respondents were local government officials, 26 percent were fire officials, 22 percent police officials, and 19 percent respondents worked for non-governmental organizations.

A majority of the respondents were male (i.e., 82 percent) with the number of years they had worked in their respective emergency management departments varying from 1 to 30 years with an average of 3 ½ years. Most of the respondents in our sample worked at the same organization averaging about 13 years of tenure.

[Table 1 about here]

Interorganizational Collaboration

We identify interorganizational collaboration based on a question in our survey instrument: "Consider the full range of organizational types including national government agencies, grassroots organization, interest groups, NGOs, and local agencies. Please list the organizations that you have collaborated with during emergency situations in order to provide assistance to disaster victims and their communities." The question was purposely designed to capture with whom local governments established

collaboration in the area of emergency management (preparedness). To determine the nature of interorganizational collaboration, we managed our data systematically as a directed matrix, where 170 organizations' interorganizational ties were coded as an N x N matrix reporting all ties among all N actors.

Network Effects

We utilized three network effects to explain the emergence of interorganizational collaboration in the research site. The **reciprocity effect** as a fundamental indicator is graphically illustrated on the left of Figure 2. For example, if actor *i* seek information from actor *j*, the tie can be operationalized as x_{ij} indicating the existence of a tie from actor *i* to *j*. The reciprocity effect can be formally defined by $\sum_{i<j} x_{ij}x_{ji}$, which accounts for the total number of reciprocal relations between actor *i* and actor *j* (Snijders *et al.* 2006; Snijders *et al.* 2010).

The **bonding effect** was measured by the "alternating *k*-triangle, parameter two," which suggests the tendency to form a highly clustered network structure is highly probable. The bonding effect is illustrated on the right of Figure 3. The structure can be formally written as: $k\sum_{i,j} x_{ij}\left\{1-\left(1-\frac{1}{k}\right)^{L_{2ij}}\right\}$, where $L_{2ij} = \sum_{h} x_{ih}x_{hj}$ is the number of two-paths connecting actors *i* and *j*. A positive parameter suggests a tendency for actors in the network to establish relations toward a comparatively high number of a closely-knit structure or a set of triangles (Steglich *et al.* 2006).

The **bridging effect** was measured by the "alternating *k*-independent two-paths, parameter two," which captures the prediction to alternatively forge a localized structure

through brokerage actors (Robins *et al.* 2009; Snijders *et al.* 2010). The bridging effect can be formally defined by: $k\sum_{i,j}\left\{1-\left(1-\frac{1}{\lambda}\right)^{L_{2ij}}\right\}$, which explains the total number of ties with exactly *k* shared actors, and the formula is based on the same definition of L_{2ij}. While a positive parameter implies a propensity for actors in the given network to utilize the actors who play a bridging role in transmitting information, a negative one proposes that the actors are less likely to share the bridging actors in expected networks by random graph.

Covariate Effects

We also included three covariate effects as control variables: (1) whether organizations are located in two of the metropolitan areas or not (2) whether organizations are located in the coastal area, and (3) whether organizations are located beside a riverbank. The covariate effect is represented by the statistic $\sum_i v_i x_{i+}$, where v_i is the value of covariate v and x_{i+} is the degree of node *i*. For the covariate effects, a positive parameter implies the attributes have an impact on the probabilities of actors to seek others in the network for information regarding emergency planning issues. A negative parameter suggests the influence of personal characteristics is improbable (Snijders *et al.* 2010).

Homophily Effects

We also tested for the homophily effect, which is represented by whether organizations in our sample are likely to form interorganizational ties with those that are similar to

themselves. The statistics for the categorical covariates is defined by $\sum_{i,j} x_{ij} I\{v_i = v_j\}$, where the indicator function $I\{v_i - v_j\}$ is 1 if the condition $\{v_i - v_j\}$ is satisfied, and 0 otherwise. For the homophily effect, a positive parameter implies that actors prefer ties to others with similar preferences (i.e., regarding the variable in the survey question). A negative parameter suggests the actors' preferences for dissimilar others will drive actors to establish ties.

Exponential Random Graph Model

The analysis for the Exponential Random Graph Model (ERGM) was performed using SIENA *P**. The logic of *P** analysis is as follows: Using the observed network (Figure 1) as the dependent variable, the *P** model can estimate the potential arrangement of network patterns that will occur from the observed network. We sought to test whether the observed network ties occur at a greater frequency than would be explained by a random graph with the same number of nodes and ties. In other words, the *P** model allows us to estimate the probability of hypothesized network sub-structures as the predictors of the observed network (Snijders *et al.* 2006; Robins *et al.* 2009).

The *P** model in SIENA uses the Metropolis-Hastings algorithm for generating random draws from an exponential random graph distribution. It employs the stochastic approximation algorithm to estimate the patterns of relationships (Snijders *et al.* 2006). The model then implements the Markov chain Monte Carlo (MCMC) estimation where the algorithm computes the maximum likelihood estimates. This allows the model to conduct a check for convergence. If the convergence diagnostic statistics for the algorithm is less than .2 in absolute value, the parameter estimate is considered to have

good convergence and excellent when they are less than .1 (Snijders *et al.* 2010). The convergence diagnostic, covariance, and derivative matrices were based on 10,000 iterations. The t-value provides a significance test of the estimated parameters.

Results And Discussion

We found almost all interorganizational collaboration tend to agglomerate on the network space in accordance with their actual geographic locations. Even though the visualized network structure (not shown here) is based on geodesic distances calculated by the degree centrality scores of each actor, the network structure shows that the emerging three regional interorganizational networks consist of their localized networks within each jurisdictional boundary. This result is consistent with findings by Lee, Lee, and Feiock (2012), indicating that the probability to establish network relationships is greatly influenced by the organizations' geographic proximity. It also implies that patterns of interorganizational collaboration during emergency response emerged within an obvious hierarchical structure aligning with the three-tier structured emergency management system from national to provincial levels and from provincial to local levels.

In order to examine the reciprocity, bonding and bridging effect, we use the ERGM with 10,000 iterations. Table 2 presents descriptive networks statistics on interorganizational collaborative networks in the SER, South Korea. In the overall network, there are 36 mutual and 957 asymmetric dyads between local organizations, and the network density is .039. In columns 2 through 6 of Table 2, we categorized the sample as five groups by types of organizations. In terms of the relationships among same organizational types (i.e., local government, fire and police stations, and

organizations in the nongovernmental sector), the density of the nongovernmental sector (.054) is greater than the overall density (.039). The density of relationships among local governments (.014) is smaller than fire stations (.016), but greater than police stations (.013). In addition, the density of relationships across sectors (.034) is much greater than relationships of other organizational types except the nongovernmental sector. More importantly, approximately 89.4 percent of asymmetric and 75 percent of mutual dyads are established by relationships across sectors.

[Table 2 about here]

[Table 3 about here]

Table 3 presents results of the ERGM analysis for interorganizational collaboration of emergency management networks. The results constitute estimated parameter values (*E*) and standard errors, and the statistical significance of the effects are based on the ratio between the parameter value and the corresponding standard error (i.e., *t*-statistics). Also, positive parameters suggest that network, covariate, and homophily effects are more likely to appear on the observed network structure than the network predicted by the random graph with same number of nodes and dyads, when holding other effects in the ERGM (Robins *et al.* 2009). As indicated earlier, the statistically significant effects provide relatively clear information about patterns of collaborative emergency management and with whom local actors formed these relationships.

The analysis results in all three models of Table 3 present evidence supporting the bonding effect, suggesting that local organizations are more likely to establish interorganizational ties with those that are closely-knitted together (E = 1.27, 1.27, and 1.12 in each model; p <.01). On the other hand, the negative estimates on the bridging effect provide an explanation that local organizations are less likely to be directly linked through those who play a brokerage role in joint emergency management activities (E = -.28, -.27, and -.27 in each model; p <.01). As argued by Murphy (2007), the results of both network effects represent the advantages of a close-knit social structure. In other words, there is an innate preference by organizations to seek close partners in joint activities rather than seeking a few organizations acting as central hubs. The confirmation of Hypotheses 1 suggests that, in a directly connected triadic structure, actors not only can secure critical information and resources that they lack but also solve collective action problems by sustaining credible commitments (Putnam, 2000).

The covariate effects of the organization type "ego" reported in Models 2 and 3 examine the likelihood that a certain type of organization (e.g., local governments, fire branches, or police stations) selects other organizations in the network. The results in Model 2 show that local governments (when compared to local fire and police stations) are more likely to forge ties with other organizations (E = .11; p <.05). The result implies that, at least in the South Korean context, local governments play a pivotal role in building interorganizational ties during emergency preparedness. Moreover, the covariate effects in Model 3 suggest that, given the presence of configurations related to network and homophily effects in the ERGM, local governments (E = .71; p <.01) as well

as fire stations (E = .32; p <.01) and police stations (E = .18; p <.05) are more likely to establish interorganizational ties with other organizations in the observed network.

In addition to the covariate effects, the homophily effects in Model 3 of Table 3 test the presence of organizational similarities across sectors, meaning the probability that organizations facing similar environmental conditions (e.g., organization located in the metropolitan area, coastal, or riverside areas) are likely to enter into interorganizational collaboration with each other. The results suggest that organizations within a metropolitan area (E = .16; p <.1) or share boundaries close to the coastline (E = .19; p <.05) are more likely to form interorganizational collaboration with those that are similar to themselves. Both results support the notion that emergency planning and decision-making processes are influenced by the similarity of environmental vulnerability (Villa and McLeod 2002). The results are not surprising, i.e., organizations with similar geographical conditions tend to secure resources from their local networks in order to cope with shared hazards (Randolph 2012).

Conclusion

Based on interorganizational collaboration among 170 organizations located in the Southern tip of the Korean Peninsula, we found the bonding effect to be dominant in explaining the pattern of interorganizational collaboration. In particular, we found that organizations are likely to develop a closed-knit structure suggesting that organizations in the southern tips of the peninsula have general preferences to seek partners that are also closed to each other for joint activities rather than seeking a few organizations acting as central hubs.

We also found local organizations within the same metropolitan areas and those located on the banks of the Nakdong River are likely to engage in interorganizational collaborations. Emergency management practitioners in small towns, cities and specialized units, and provincial governments knowing that they are likely to be overwhelmed in a major disaster—an implicit fact in a disaster (Fritz 1961, 655)— form consortia for emergency planning, information exchange, and strategic development. It is these partnerships established through a string of social ties that facilitate the development of an effective emergency response system at the local level, overcoming the scalar contradictions of capacity and local control that are particular to federalist governance.

Although we have examined the patterns of interorganizational collaboration in the southern tip of the South Korea peninsula, we have not associated the interactions with specific tasks. Future research needs to explore these associations in order to tease out the social structure that could be a predictor of successful coordinating efforts. Our empirical study is also limited to the region and thus may not apply to other regions in the country. Despite these weaknesses, one of the strengths of this study is the illustration that organizations in the region seek ties with those familiar to them, presumably for social support, redundancy of resources, and organizational reputation. Through the process, they develop new norms and behavior patterns, and emergency practices. The results based on our empirical study, elucidating that in South Korea, emergency response organizations and local governments tend to rely on these close connections to get the job done.

We are not arguing that hierarchical governance does not matter. As suggested by other authors, interorganizational collaboration developed horizontally is not replacing vertical governance structure (Kettl, 2002; Heinrich, Hill, and Lynn 2004). It simply emphasizes the important role that interorganizational ties can play in supplementing the vertical ones (Kettl 2002: 128). An interorganizational collaboration also suggests we must take into account an overlapping formal authority. As Bardach (1998: 21) pointed out more than two decades ago, "inter-organizational collaborative capacity is very much like an organization in its own right." While some scholars describe a collaborative approach to management as "shared administration" (Pressman and Wildavsky 1973), others put more emphasis on activities of public managers as "a key process in collaboration" (Bryson, Crosby, and Stone 2006: 45).

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Table 1: Respondents by Organizational Types

	July/August 2012	
Organizational Types	**Frequency**	**Percent**
Local Government	43	33.1
Fire Station	34	26.2
Police Station	28	21.5
Nongovernmental Organization	25	19.2
Total (Response)	130	
Referred Organizations	40	
Total (Overall)	170	

Table 2.
Networks Statistics

	Overall Network	**Among Local Governments** Gov ←→ Gov	**Among Fire Stations** FS ←→ FS	**Among Police Stations** PS ←→ PS	**Among NGOs** NGO ←→ NGO	**Across Sectors**
Dyadic Counts	13,041	903	741	741	435	10,100
Mutual	36	4	2	2	1	27
Asymmetric	957	22	19	15	45	856
Null	12,048	879	720	724	389	9,336
Network Density	.039	.014	.016	.013	.054	.034
Average Degree	6.35	.61	.59	.49	1.57	5.45

Table 3.
Exponential Random Graph Model

	Model I		Model II		Model III	
	Estimates	Std. Err.	Estimates	Std. Err.	Estimates	Std. Err.
Network Effects						
Reciprocity	-.17	.226	-.27	.275	-.19	.226
Alternating k-triangles (Bonding)	1.27***	.027	1.27***	.036	1.12***	.038
Alternating k-independent 2-paths (Bridging)	-.28***	.012	-.27***	.013	-.27***	.013
Covariate Effects						
Local Governments (ego)			.11**	.054	.71***	.080
Fire Stations (ego)			.07	.050	.32***	.060
Police Stations (ego)			.02	.045	.18**	.082
Homophily Effects						
Metropolitan Area					.16*	.084
Coastal Area					.03	.076
Riverside Area					.19***	.041

Coefficients from a standard SIENA (3.2) ERGM analysis of directed network matrix.

All statistics converged with a *t*-statistic <0.1 with a minimum of 10,000 iterations.

*p<.1, **p<0.05, ***p<.01