

Networks and Contexts: Variation in the Structure of Social Ties¹

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A core axiom of sociology is that social structure affects and is affected by human behavior. The term “social structure” conveys two quite different meanings. One meaning is relational, involving networks of ties between individuals or groups of individuals. A second meaning refers to the contexts containing these individuals. Studies of neighborhood and community effects depend on variability in both types of social structure. Using data from multiple villages in Nang Rong, Thailand, this article documents substantial variability in network structure and shows that network structure covaries with context in meaningful ways, suggesting reciprocal effects of changes in both. Finally, it considers implications of variability in network structure, showing that social cohesion affects the likelihood of finding and interviewing former village residents.

A core axiom of sociology is that social structure affects and is affected by human behavior, but exactly what this means is not always clear. The term “social structure” has come to symbolize quite different aspects of the larger world in which people live. One meaning is relational, involving ties between individuals or groupings of individuals such as households. These ties may involve kinship, friendship, neighbor relations, social sup-

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port, and so forth. A second meaning relates to the social units within which individuals and groups of individuals are contained. Schools, firms, voluntary associations, and neighborhoods are examples of these social units. To fix terms, we refer to the former as “networks” and the latter as “contexts.” Although some progress has been made, these perspectives have yet to be fully integrated. This article bridges networks and contexts to advance our understanding of neighborhoods, villages, and communities.

Over the past two decades, numerous studies have documented the existence of contextual effects, and, unfortunately, there has been a tendency to stop there. Social processes that might explain these effects are frequently neglected. In their review of the neighborhood effects literature, Sampson, Morenoff, and Gannon-Rowley (2002, p. 447) observe: “Although concern with neighborhood mechanisms goes back at least to the early Chicago School of sociology, only recently have we witnessed a concerted attempt to theorize and empirically measure the social-interactive and institutional dimensions that might explain how neighborhood effects are transmitted.” Indeed, we do not even know whether and to what extent the interactional or network structures vary from one neighborhood, village, or community to the next. Such variation is fundamental to whatever role they might play, either in their own right or as a mediator of the effects of context. Also unknown is how network structures covary with other attributes of context. Drawing on a unique data set for Nang Rong district, Northeast Thailand, this article documents substantial variability in the structure of social relations across villages. It shows that network structure covaries with context in meaningful ways, in a pattern that suggests that change in social networks might induce a change in context, as well as vice versa. Finally, it considers the implications of variability in network structure for an individual-level outcome in an illustrative analysis, showing that the results are consistent with theoretical expectations.

CONTEXTS AND NETWORKS

Studies of neighborhood effects represent a “growth industry” in the social sciences. Hundreds of articles having “neighborhood” in the title have been published in the last five years (Sampson et al. 2002; also see Gephart 1997).² Studies of neighborhood effects have examined self-reported health

² A search of Sociological Abstracts for the years 2000–2004 (inclusive) turned up 364 items with “neighborhood” in the title. A search of ISI Web of Science, limiting the search to social sciences, turns up 710 results. The counts include articles in refereed journals and also Web sites, conference presentations, and the like.

(e.g., Ross and Mirowsky 2001), cancer mortality (e.g., Smith and Waitzman 1997), heart disease mortality (e.g., LeClere, Rogers, and Peters 1998), age- and sex-adjusted death rates (e.g., Yen and Kaplan 1999), and health care access (e.g., Kirby and Kaneda 2005). They have examined achievement in school (e.g., Blau et al. 2001; Catsambis and Beveridge 2001; Ginther, Haveman, and Wolfe 2000), drug use (e.g., Boardman et al. 2001), adolescent sexual activity (e.g., Browning et al. 2004), resolution of adolescent premarital pregnancy (e.g., South and Baumer 2001), and adolescent childbearing (e.g., Ginther et al. 2000). Some look at marital timing (e.g., South and Crowder 2000) and intermarriage (e.g., Hwang, Saenz, and Aguirre 1997). Others look at low birth weight (e.g., O'Campo, Wang, and Caughy 1997) and parenting behaviors (e.g., Pinderhughes et al. 2001). Still others are interested in residential mobility (e.g., South, Crowder, and Chavez 2005) and migration (e.g., Boyle and Shen 1997).

Studies of neighborhood effects typically focus on urban areas of developed countries (although see Montgomery and Hewett 2005), but another literature has developed in tandem that focuses on community effects in rural areas of developing countries. As with studies of neighborhood effects, this parallel literature on community effects is addressed to diverse outcomes, including sexual activity (e.g., Gupta 2000), marriage patterns (Fricke, Thornton, and Dahal 1998), contraceptive use (McNay, Arokiasamy, and Cassen 2003), childbearing (e.g., Axinn and Yabiku 2001), infant mortality (e.g., Kanaiaupuni and Donato 1999), migration (e.g., Ezra and Kiros 2001), and land use (e.g., Perz 2001). There are many commonalities between the two literatures—most important, both are guided by similar sets of theoretical concerns. In both, the question is whether local contexts affect the behaviors of individuals, and if so, how? Both tend to implement similar research designs, focusing on the impact of socioeconomic and demographic characteristics measured at the contextual level, controlling for individual socioeconomic and demographic characteristics.

This approach owes much to an early theoretical formulation by Blau (1960), who proposed two types of contextual effects, one based on local variability in opportunity structures and the other on normative variability. The operational model included, in its simplest form, a contextual variable, its individual-level counterpart, and an individual-level outcome (see fig. 1). The indirect effect of the contextual variable through its individual-level counterpart, that is, paths *b* and *c* in the diagram, is interpreted as the effect of opportunity structure. The direct effect of the contextual variable net of its individual-level counterpart, path *a* in the diagram, is interpreted as the effect of normative environment. Empirical analysis focused on the relative strengths of these two effects in a multilevel design (i.e., individuals nested in contexts).

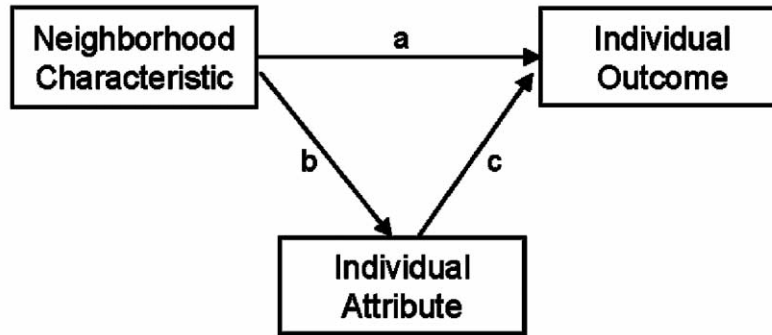


FIG. 1.—Neighborhood and individual effects on individual-level outcome

Blau's (1960) approach to empirical modeling survives to this day, but the theoretical underpinnings have largely been lost. Nowadays, analysts begin with models conceptualized and operationalized at the individual level, appending measures of local area characteristics derived from the census, administrative records, or special surveys. Neighborhood, village, or community effects are said to exist if local area characteristics have effects "above and beyond" those of predictor variables measured at the individual level. The literature has become preoccupied with whether contextual effects exist given a competition between individual and neighborhood effects. Blau's (1960) essential insight, that contextual effects operate through, and in concert with, individual effects, is little in evidence.

Reasons why local contexts might matter for individual behavior can be classified in a variety of ways. For example, Jencks and Mayer (1990) identify neighborhood institutional resources, community social organization and collective socialization, contagion, competition for scarce community resources, and relative deprivation as possible mechanisms explaining neighborhood effects. Leventhal and Brooks-Gunn (2000) reclassify these into three categories: institutional resources, relationships, and norms/collective efficacy. Sampson et al. (2002) propose a similar organizing scheme: social ties and interaction, norms and trust, institutional resources, and activity patterns. For Moffitt (2001), the distinction is between economic and social mechanisms. As we now discuss, patterns of social interaction are a common element in all of the classification systems just enumerated. These patterns, in turn, are related to features of neighborhoods and communities directly relevant to their potential impact on individual behavior.

There are at least four ways in which patterns of social interaction relate to local contexts and their effects. The first involves social cohesion.

The development of the term “social cohesion” or “social integration” dates back to Durkheim’s concept of solidarity (Durkheim 1949) and is clearly defined by Schacter (1968) as “the social forces that draw and bind men [and women] together.” Social cohesion itself is not necessarily a good thing—it could have positive effects by bringing people together in supportive acts (e.g., neighborhood associations, trading favors, etc.), or negative effects by bringing people together in detrimental acts (e.g., gangs). Thus, it is not the presence or absence of cohesion per se, but the nature of cohesion that affects neighborhoods and the individuals who reside there (Blokland 2000). At the level of the neighborhood or community, one ideally measures social cohesion through a description of the relational structure of the entire context, such as the strength and nature of social ties in the neighborhood or community as a whole. However, we know of no study that has actually done this. Rather, social cohesion is measured through individual respondents’ reporting about the structure and closeness of the social relationships in their neighborhood. In this article, we measure cohesion based on the relational structure of entire villages, examine associations with other characteristics of those villages, and consider its consequences for whether or not former residents of those villages can be found and participate in a migrant follow-up survey.

A second way in which patterns of social interaction relate to local contexts and their effects involves social capital. Concepts of social capital express the value of social interactions and exchanges to individuals, families, communities, and societal well-being (Coleman 1988; Putnam 1993, 1995; Portes 1998; Woolcock 1998; Astone et al. 1999; Feldman and Assaf 1999; Paxton 1999; Lin, Cook, and Burt 2001). Social capital refers to the social organizational components that can be used by individuals or groups for undertaking certain actions (Coleman 1988; Putnam 1995; Portes 1998; Woolcock 1998; Lochner, Kawachi, and Kennedy 1999). Due to the complexity of the concept, social capital has been conceptualized and measured in multiple ways. Our interest is in aspects of social capital potentially relevant to local contexts and their impacts. We are especially interested in the extent and nature of social ties to neighbors, as well as the composition and density of these locally based social networks. To date, there has been little empirical research regarding the impact of social capital at the neighborhood or community level, and the research that has been done has relied on indirect measures (e.g., SES, income inequality, and geographic isolation [Israel, Beaulieu, and Hartless 2001]). We use direct measures of social ties.

Third, patterns of social interaction are relevant to concepts of informal social control. Social control is defined as “the capacity of a group to regulate its members according to desired principles—to realize collective, as opposed to forced goals” (Sampson, Raudenbush, and Earls 1997). It

is seen as a positive force that can improve neighborhoods and individual-level outcomes. Much of the current interest in neighborhood social control is based on Shaw and McKay's social disorganization theory, which posited that poor structural characteristics of neighborhoods (i.e., poverty, high residential mobility, etc.) reduce social control and allow for deviant behaviors which adversely affect neighborhoods (Shaw and McKay 1942; Sampson and Groves 1989; Veysey and Messner 1999). Although social control is a neighborhood-level concept (social control cannot be exerted by one individual), it has been measured by individuals' responses to questions about their willingness (or that of their neighbors) to intervene or take action in the neighborhood to stop negative actions (Sampson et al. 1997; Wikström and Dolmén 2001). Research to date has been carried out mainly by criminologists, focusing on delinquency and other problem behaviors (e.g., Elliot et al. 1996; Sampson 1997; Sampson and Groves 1989; Veysey and Messner 1999). Informal social control may also encourage positive behaviors, such as hospitality and cooperation, and this is a possibility that we will explicitly consider in our illustrative analysis of migrant follow-up.

Fourth, the concept of collective efficacy unites the first concept of social cohesion and the third concept of informal social control into a single concept indicating "the linkage of mutual trust and the willingness to intervene for the common good" within a given neighborhood (Sampson et al. 1997). It is operationalized as a combination of two scales—one measuring neighborhood residents' willingness to intervene in a number of instances (social control), the other measuring residents' perceptions of the closeness, friendliness, and trustworthiness of the people in the neighborhood (social cohesion). In terms of empirical evidence, collective efficacy was found to reduce neighborhood violence and disorder, and to mediate the effects of residential instability, disadvantage, and disorder on violent crimes in Chicago (Sampson et al. 1997; Sampson and Raudenbush 1999).

Patterns of social interaction are fundamental to social cohesion, social capital, informal social control, and collective efficacy within local contexts. Undoubtedly, these patterns of social interaction are related to other characteristics of local areas as well, and, indeed, likely serve as a mechanism to transmit the effects of these other characteristics on individual outcomes. Thus far, however, no study of local contexts and their effects has measured the structure of social ties and interaction directly at the neighborhood, village, or community level, attempted to trace relationships to other characteristics at that same level, or followed the implications of these patterns for an outcome at the individual level. Rather, the structural features of locally based social networks have been inferred from the reports of individual respondents, measured indirectly, or simply

presumed to operate. A general lack of complete network data for neighborhoods, villages, and communities explains this mismatch.

This article draws on unique social network data for villages in Nang Rong, Thailand, to fill these gaps. Based on an empirical examination of network data across two types of social ties and across 51 villages, we first explore variability in network structure. Then, after showing that such variability exists, the article goes on to consider the strength of association between measures of network structure and other measures of context. This analysis speaks directly to whether and how context effects might be mediated by social structural features, and also how network structure might itself affect the characteristics of context. The article continues with an illustrative analysis of the consequences of network structure for success in finding and interviewing former residents of villages in a follow-up of migrants to major urban areas. The conclusion reviews the results in terms of what is learned about the network structure of villages in Nang Rong and considers the results in terms of their larger implications for our understanding of neighborhood and community effects elsewhere.

NETWORKS AND VILLAGES

Views of village contexts in rural areas of developing countries today often rely on outdated images of spatial and social isolation, social homogeneity, and tightly integrated, overlapping social ties. The writings of classic sociological theorists have contributed to these stereotypes. For example, in *The Eighteenth Brumaire of Louis Bonaparte*, Marx characterized preindustrial rural villages of the mid-19th century as “potatoes in a sack.” Villages vary in shape and size, according to this metaphor, but not in essence, and, logic extended, studying one is sufficient to understanding what is occurring in many. In *The Division of Labor in Society*, Durkheim describes a type of social organization, “mechanical solidarity,” in which unity and social cohesion are achieved through commonality. Mechanical solidarity is found in peasant societies. In *The Theory of Social and Economic Organization*, Weber distinguishes types of authority according to their social basis. Patrimonial forms of authority and organization rely on overlapping kin and economic ties.³

Although images of isolation and homogeneity continue to influence the thinking of some sociologists, those who work in rural areas of de-

³ This traditional view of rural societies also underpins sociologists’ discussions of differences between urban and rural settings in developed countries, though both the contrast between the social structures in the two settings and the assumed uniformity of rural contexts has been questioned (Beggs et al. 1996 and references cited therein).

veloping countries know from experience that these images are incorrect, at least today. Villages are not isolated; nor are they homogeneous with respect to size, migration patterns, age and sex structure, average levels of education, involvement in agricultural production, or the penetration of the mass media. Indeed, such variability is presumed in studies of village effects. Little is known about variability in the structure of social ties, however. In contrast with characteristics that are straightforward to measure, such as migration flows, economic activity, land holdings, and ownership of consumer durables, measuring the structure of social ties requires types of data that are seldom available in surveys. To “see” variability in the structure of social ties requires information not only on direct ties, but also indirect ties; not just for one social relation, but several; not just in one local community, but many. It requires complete network data for multiple villages, ideally on multiple social relations—data available for Nang Rong district, Northeast Thailand.

What would we expect with respect to variability in the structure of social ties? If we believe the stereotype, we would not expect to see much variability. Villages would tend to be self-contained, with few ties to the outside. Within villages, social ties would be relatively dense, with all households linked directly or indirectly. Kinship would be the principal axis of organization, but kin ties would map onto economic ties, and vice versa (Schweizer and White 1998). In other words, we would expect village-based social networks having high cohesion, substantial multiplexity (i.e., the extent to which kinship, friendship, economic, or helping ties overlap), and little boundary permeability. We would expect little variability across villages in these characteristics. These are expectations that we examine with data for 51 villages in Nang Rong, Thailand.

Nang Rong district is located in Buriram Province, in Northeast Thailand. The district is 1,300 square kilometers—approximately the size of an eastern U.S. county. The population was 183,000 in 1990 (National Statistics Office 1990). Villages are relatively small, organized as clusters of dwelling units surrounded by agricultural lands.⁴ Agriculture, principally paddy rice cultivation, dominates the local economy. The soils are poor, and rainfall is unpredictable (Parnwell 1988). Floods and droughts are common (Fukui 1993). The Northeast region, including Nang Rong, is the poorest in Thailand.

Our data on social ties come from the 1994 Nang Rong Household

⁴ Nang Rong was once tied to the Ankor empire, which collapsed sometime in the 15th century (Rooney 1999). Little is known about the subsequent period, but at the turn of the 20th century, Nang Rong was a frontier area, heavily forested and large tracts of land ambiguously titled. New settlers migrated into the region, especially after World War II. The research reported in this article is based on villages as defined in 1984, the beginning of the social survey data collection for the Nang Rong studies.

Survey (Rindfuss et al. 2004).⁵ This survey collected data for all households in each of 51 villages in the district. An innovative feature of the household survey was the collection of complete household networks within each of these villages. Other studies have collected complete network data for numerous networks in schools (Harris et al. 2003), classrooms (e.g., Hallinan 1974; Snijders and Baerveldt 2003; Lubbers 2003), or firms (e.g., Athanassiou and Nigh 1999). We know of only one other study that has collected complete network data in multiple neighborhood, village, or community contexts: a study of all married women of reproductive age living in 25 villages in Korea in 1973. These data have been analyzed by Rogers and Kincaid (1981), Valente (1995), Kohler (2001), and others, but never from the perspective we take here.

Ties to other households in the village from sibling relationships and help with the last rice harvest were collected in the 1994 Nang Rong Household Survey.⁶ For household members ages 18–35, the locations of their siblings were recorded. The question asked was, “Does this person have other siblings besides the ones [living in the household] that are still living? If they do, record their current location.” For each sibling not in the respondent’s household, current location identified a specific household if that household was in the village, a specific village if that village was within Nang Rong district, a specific district if that district was in Buriram province. If the sibling was outside Buriram province, then the province was recorded. The other relation is help with the rice harvest. Households were asked whether they planted rice in the last year. If yes, they were asked, “Did anyone from this village help to harvest rice in the last year?” and “Did anyone from another village come to help harvest

⁵ The Nang Rong study was begun in 1984, when the district was selected by Thailand’s Population and Development Association (PDA) for the Community-Based Integrated Rural Development (CBIRD) project. The intervention was designed to (1) improve skills and productive capacity in agriculture, animal husbandry, and various cottage industries, such as raising silk worms; and (2) upgrade waste disposal facilities, increase year-round availability of drinking water, and promote health practices. At that time, the district was quite poor by Thai standards. To evaluate the success of the CBIRD project, PDA arranged for the Institute for Population and Social Research (IPSR) to design and conduct a multilevel baseline survey in 1984. Within Nang Rong, villages were selected to participate in the project and to serve as controls. This experimental design was abandoned when it became clear that spillover effects undermined the distinction between the two sets of villages. The analyses reported in this article draw mainly on data collected 10 years later, in 1994. Neither the region nor the villages were selected for their heterogeneity.

⁶ Information about the renting, hiring, and sharing of agricultural equipment from other households in the village and from households in other villages in the district was also collected. There were questions about large tractors, small tractors and tillers, generators, water pumps, and threshers. The equipment hiring network is extremely sparse in all the villages, and for this reason, we do not report on it here.

rice in the last year?" Responses were recorded to the same level of geographic specificity as the sibling ties.

As is well understood in the social network literature, there is no single "social tie" defining village or neighborhood social structure. Indeed, the network structure of a village consists of multiplex social, economic, political, and other relations and their associations with each other. In addition to siblings and help with the rice harvest, there are other types of kin and economic ties that might be studied. Other kin ties include ties between marital partners and between generations. The variety of economic ties that we might consider is even wider, including planting of rice as well as the harvest, the cultivation of other crops, various arrangements concerning land (e.g., rental), small businesses (e.g., rice mills, repair shops), and so forth. While sibling ties represent a form of kin tie, we do not expect our findings for sibling ties to generalize to all kin ties. Nor do we expect our findings for help with the rice harvest to generalize to all economic ties. Nevertheless, these two ties allow us to investigate different aspects of village networks and possible variability in networks across villages.

For both relations, our focus is households. Households are important social and economic units in rural settings (e.g., Becker 1991; Chayanov 1966; Kriedte, Medick, and Schlumbohm 1981; Rosenfeld, 1985; Stark 1991; Wilk and Netting 1984). Historically, as land in Northeast Thailand was occupied, families would only work a piece of land sufficient for family consumption (Phongphit and Hewison 2001). Today in Nang Rong, villages are composed of farmers with small holdings cultivating paddy rice primarily but also upland cash crops such as cassava, kenaf, and corn. Households are a key unit of production and consumption. In addition, methodologically, a focus on households made it possible to collect complete network data within villages.⁷

These network data permit the study of the overall structure of social ties in the villages. We can look at households linked through direct and indirect ties to other households, and we can study cohesive subsets of households in villages. To illustrate, figure 2 shows a hypothetical network of sibling and rice help ties between households in a village. If network

⁷ Villages consisted of a manageable number of households from the standpoint of data collection. Among the 51 villages in 1994, the average village had 144 households containing an average of 4.2 residents. Village heads kept track of households for their own administrative purposes, so a list was available at the outset. Finally, while we collected information about all residents of all households in the study villages, we did not interview each household resident separately. We collected information from household informants. This approach would not be appropriate for the collection of data about the social ties of individuals, other than the informant, but it worked wonderfully well for the collection of data about the social ties involving households.

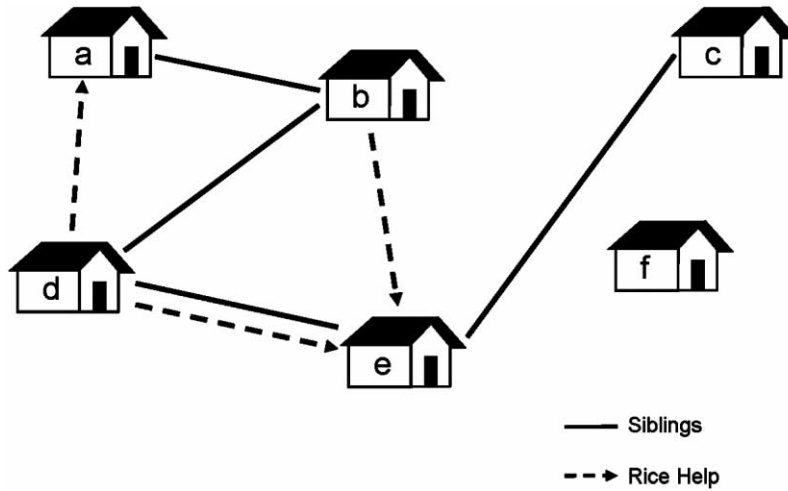
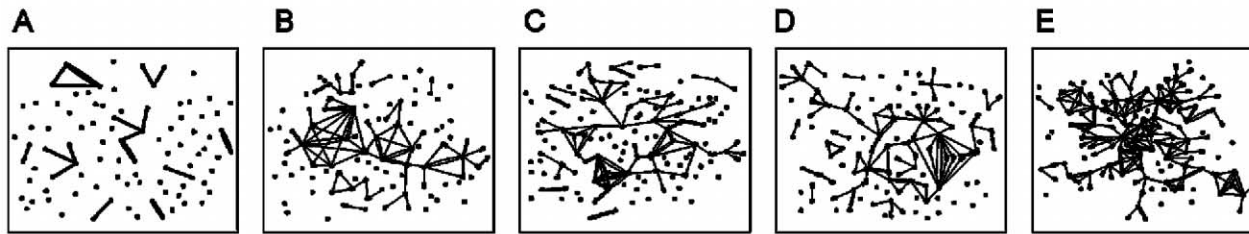


FIG. 2.—Hypothetical network of sibling and rice help ties between households

ties had only been collected for a sample of households rather than for the complete network, several important properties would be missed. It would not be possible to see that household *a* is connected indirectly to households *d*, *e*, and *c* through sibling ties (following the chain of sibling ties: *a-b-d-e-c*). It also would not be possible to tell that households *b* and *d*, which are both providing help to *e*, also share a sibling tie. Moreover, if a sample of households were asked only about help received, one might not be able to tell that *d* provided help to two different households. Complete network data also allow us to calculate overall network-level measures of social structure. In this hypothetical example, five of the six households (83%) are connected to one another through sibling ties (*a*, *b*, *c*, *d*, and *e*) and four of the six (67%) through rice help ties (*a*, *b*, *d*, and *e*). Household *f* has no sibling ties within the village (it is an isolate), and both *c* and *f* are isolates in the rice help network.

Complete network data also allow us to characterize network patterns at the village level. As a first look at the structure of the household networks within villages, and at potential differences between villages, we show graphs of the data for five villages in figure 3. The top panel shows the sibling networks, the bottom panel, the rice harvest networks. Each enclosed rectangle in these figures represents a village, the points within these rectangles represent households, and the lines between the points represent social ties between households. Letters identify each village and are the same across the two panels. Villages were selected as follows. Village A has the sparsest sibling network (the fewest ties per

Sibling Ties



Help with the Rice Harvest

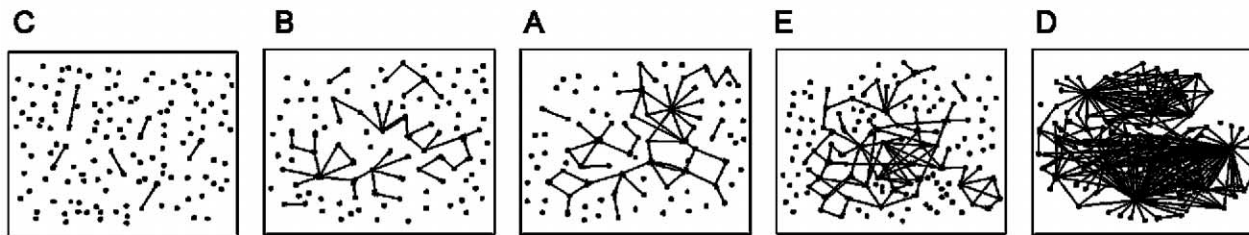


FIG. 3.—Ties between households in five Nang Rong villages

household, on average), and village E the densest sibling network. Village C has the sparsest rice harvest network, and village D the densest one. Village B is the median for the sibling network and is close to the median for the rice harvest network. In each panel of the figure, villages are arranged in order of network density, from the sparsest (on the left) to the densest (on the right). The location of the points representing households in these figures is arbitrary, selected to maximize the visibility of social ties, and is not the same across the two panels.

Looking first at the top panel of figure 3, there is substantial variability in the density of sibling ties. In village A, sibling relationships create few links between households, whereas in village E, the large majority of households are linked, directly or indirectly. The two pictures look remarkably different. Possible causes of these differences may include differences in the timing and speed of fertility decline (such that village A has smaller sibsets), involvement in migration streams (such that more young people migrate out of village A), and residential patterns (such that the young people who live in village A reside with their parents rather than forming their own households). In fact, village A has the fewest households, the smallest household size, and the most extensive out-migration of any of the five villages. In contrast, village E is the largest of the villages, with the second-largest household size and the least out-migration.

Turning to the bottom panel of figure 3, there is substantial variability in the density of rice harvest ties as well. In village C, only a few households gave or received help from other households. The contrast with village D, where almost every household gave or received help, is dramatic. Potential causes of the differences between these two villages may include differences in the location of the village and suitability of the land for paddy rice cultivation (such that village C is less involved in rice cultivation, and to the extent that it is involved, the productivity of the land is less); trends in fertility, migration, and household formation (such that households in village C are larger and labor needs more easily met from within the household); or possibly methods of cultivation and harvesting (such that machines substitute for human labor more in village C).

Comparing the two panels is instructive. Recalling that the location of households in the graph for each village is arbitrary and shifts between the two panels of the figure, we look instead at the position of villages on the continuum of network density between the two panels. There is quite a bit of movement. Village A, which has the sparsest sibling network, is above the median on density of the rice harvest network. Village C, which has the sparsest rice harvest network, is above the median for the sibling network. The villages with the densest networks on these two

relations, villages E and D, simply trade places between the two panels of the figure, but the structure of social ties shown in these pictures is quite different. Based on figure 3, it does not appear that, overall, kin ties map to economic ties, or vice versa. Rather, these networks appear to be quite distinct.

We now turn to a more formal consideration of network measures. Our concern is in measures that characterize village-level network properties and capture theoretically important features that might underlie contextual effects. In particular we focus on three general kinds of network properties: cohesion, permeability of network boundaries, and multiplexity (the extent to which ties on two different relations occur together). We first define and illustrate these measures for the five sample networks in figure 3, and then present descriptive statistics for the 51 villages.

The cohesion of a network describes how connected members are through direct or indirect ties. Networks in which actors have more ties, on average, are more cohesive than those in which actors have fewer ties. Networks in which actors can reach many others through direct ties or indirect paths are more cohesive than are networks in which relatively few are reachable. The more cohesive a network, the more likely that information can travel through social ties to all members and that activities can be coordinated among network members.

From among the various measures of cohesion (Friedkin 2004; Moody and White 2003; Wasserman and Faust 1994), we use three: the average percentage of households that are directly tied to a household, the average percentage of households that are reachable through indirect paths in the network, and the percentage of households that are isolates in the village. These cohesion measures are based on the connectivity of the network or the ability (or inability) of actors to reach others, directly and via indirect paths. Connectivity is measured using paths in a network. A path in a network is a sequence of nodes and edges (actors and ties), beginning and ending with actors (a path also requires no actor or tie be included more than once). To illustrate, consider sibling ties in the hypothetical network shown in figure 2. There is a path from household *a* to household *c* using sibling ties through the path *a-b-d-e-c*. Households *a* and *c* are said to be reachable. Within the set *a, b, c, d, and e*, each household can reach all of the remaining four in the set. In other words, they can reach four of the other five households in the network (80%). (We ignore the direction of ties in computing this measure, considering a tie to be present between two households if either one nominated the other.)

The first measure of cohesion that we use is the average percentage of other households that are directly tied to each household—in other words, the average percentage reachable in a path of length one. The second measure of cohesion is the average percentage of households that are

reachable from each household in the village. This measure is equal to 100% if all households in the village are connected to each other through direct or indirect paths. It is 0% if all households are isolates. Returning to the five sample villages in figure 3, consider rice help ties in village D in the bottom panel. In this village all but two households are connected to one another through paths of rice help ties. For households in this village the average percentage of other households that are reachable through rice help ties is 97%—a very cohesive village. In contrast, in village E the average percentage of households reachable through rice help ties is 22%, and in village C it is only 1%. A third and complementary measure of cohesion is the percentage of households that are isolates—actually a measure of the lack of cohesion. An isolate is a household that has no ties within the village on a given relation (it may have ties outside the village or it may have ties on other relations). Again, to illustrate, consider rice help ties in figure 3. In village C, 90% of the households are isolates, whereas in village D only 2% are.

Cohesion refers to the structure of social ties within villages, but it would be a mistake to ignore ties outside the village. Nang Rong is a source area for migrants to Bangkok and the Eastern Seaboard. Households have ties outside the district by virtue of these migrant flows. The economic and kin ties of interest to us likewise may extend to these other places. Further, at marriage, a young couple that decided to stay in agriculture might locate in her village or his (Chamratrithirong, Rindfuss, and Morgan 1983), and hence marriage may forge ties to other rural villages. These ties demonstrate the permeability of administratively determined village boundaries to social and economic ties.

Two village-level network variables quantify the permeability of village boundaries. On each relation households were asked about ties both inside and outside the village. For sibling ties, household members ages 18–35 were asked the locations of their siblings. For each household that named any siblings, we calculate the percentage of siblings outside the village, and then take the mean for households in the village (excluding households that did not name any siblings).⁸ The permeability variable for rice help is calculated similarly. It is the average percentage of rice harvest helpers who were from outside the village (excluding households that did not name any rice helpers). Returning to the five sample villages in figure 3, in village A, which is the sparsest on sibling ties inside the village, households average 90% of their siblings outside the village. Compare that to village E, which is the densest on sibling ties inside the village. In village

⁸ If a household named no siblings living outside the household, either inside or outside of the village, then the percentage of ties outside of the village is undefined, and it is excluded from the village mean.

E, an average of 58% of sibling ties are outside the village. A similar pattern holds for rice help from outside the village. In village D (the densest), on average 38% of ties are outside the village, and in village C (the sparsest), the average is 78%.

Our final village-level network measure indicates the multiplexity of pairs of relations. Multiplexity is the tendency for two relations to occur together. We can look at whether households named as the source of help with the rice harvest also house named siblings. Our measure of multiplexity is the Pearson product moment correlation between the two relational variables (Wasserman and Faust 1994). The unit of observation for this calculation is an ordered pair of households (if there are N households in the village, then there are $N \times [N - 1]$ ordered pairs of households). The correlation is calculated between sibling ties and rice help ties. This measure is sometimes called the “matrix correlation” since it is the correlation between corresponding entries in two sociomatrices (one for each of the relations being compared). A positive correlation indicates multiplexity between the two relations.

Table 1 shows the variability in the network properties across the 51 villages.⁹ Villages vary widely in their cohesiveness. For siblings, the mean percentage reachable across all villages is 10.7%, but the range is from 1.0% in the least cohesive village to 61.0% in the most, with a standard deviation of 13.0. Variability is similar for the percentage of households that are isolates. In the most cohesive village less than 9.8% of the households are isolates on sibling ties, and in the least cohesive village more than half are isolates. Variability among villages is even greater on rice help ties. The percentage reachable on rice help has a range from 1.0% to 97.0%, with a standard deviation of 16.9. The percentage isolates ranges from 1.7% to 91.3%. With respect to the permeability of village bound-

⁹ The particular measures of village network properties that we use capture different aspects of network structure. Obviously these are not the only measures we could have used. Cohesion is sometimes measured by the density of the relation (the proportion of ties that are present in the network) or by the average number of ties (in or out degree) of each point. We looked at these, but chose to use the percentage directly tied to households, the percentage reachable, and percentage isolates instead since they better capture the overall cohesion of the networks in terms of the connectedness of households through indirect paths. The conclusions reported in the next section on substantive relationships between network variables and context variables are substantially the same using alternative measures of cohesion. We also considered the centralization of each relation, measured using the variance of the number of ties (the variance of the degrees of the households). Centralization quantifies the variability or inequality in levels of activity among network members. For our networks, centralization is highly correlated with the density of the relation—high levels of centralization occur in villages where the average number of ties is high. Because of this redundancy and because cohesion is more often cited as an important social structural factor in the community and neighborhood effects literature, we use cohesion.

TABLE 1
 CHARACTERISTICS OF SOCIAL NETWORKS IN 51 VILLAGES: DESCRIPTIVE STATISTICS FOR
 MEASURES OF COHESION, BOUNDARY PERMEABILITY, AND MULTIPLEXITY

Network Measures	DESCRIPTIVE STATISTICS			
	Mean	SD	Min	Max
Mean percentage of households reachable:				
Sibling ties	10.7	13.0	1.0	61.0
Help with the rice harvest ...	10.8	16.9	1.0	97.0
Mean percentage of households reachable, path 1:				
Sibling ties .....	.92	.38	.29	1.98
Help with the rice harvest ...	.68	.68	.06	4.28
Percentage of households that are isolates:				
Sibling ties	25.7	9.5	9.8	53.3
Help with the rice harvest ...	58.1	18.7	1.7	91.3
Mean percentage of ties that are outside the village:				
Sibling ties	76.2	7.5	58.1	90.1
Help with the rice harvest ...	46.7	17.3	15.7	82.0
Multiplexity:				
Siblings and rice harvest .....	.072	.048	-.006	.188

aries, again we see considerable variability, and this variability is greater for rice help than for siblings. Villages range from an average of 58.1% to 90.1% of siblings outside the village. The range of rice help from outside the village is 15.7% to 82.0%. The results for multiplexity are less striking, in part because the overall levels of multiplexity are low (across villages, the mean correlations for all pairs of relations are below 0.1). Across villages the correlations range from essentially zero to just less than +0.2. Nevertheless, overall the results shown in table 1 reveal remarkable variability in social structure among the 51 villages.

NETWORKS AND CONTEXTS: THEIR INTERPLAY

Given such variability in social network structure, the next step is to inquire about its correlates. How might social network structure be related to other dimensions of social life? How do villages come to differ in the integration, permeability, and multiplexity of their social networks? What implications do the characteristics of social network structure have for village context? Sociologists have considered these questions in relation to urban life (Amato 1993; Beggs et al. 1996; Fischer 1982; Hofferth and Iceland 1998; Kasarda and Janowitz 1974; Litwak and Szelenyi 1969;

Wirth 1938), but they have received less attention in relation to rural life. Even the literature on contemporary urban life is fragmentary.

Our approach is exploratory, which is appropriate given the absence of a comprehensive theory of the determinants and consequences of the structure of social ties within villages, or neighborhoods or communities, for that matter. We are interested in correlations between network characteristics and context characteristics. For this purpose, we rely on canonical correlation analysis, a technique well suited to the assessment of correlations between two sets of variables.¹⁰ In our analysis, one set of variables consists of the nine measures of village-level social network structure described in the previous section of the article. The other set consists of 22 variables measuring the demographic, economic, and sociocultural characteristics of the 51 village contexts. Basic information about these variables is given in appendix A. The descriptive statistics provided there confirm that villages in Nang Rong differ in size, composition, turnover, economic organization, consumer lifestyle, use of technology, and dialects spoken. These demographic, economic, and sociocultural characteristics may affect the choices and behaviors of village residents directly, or indirectly through network structure. For the latter to be true, there must be some correlation between the contextual and network variables.

For two sets of variables, canonical correlation analysis finds the best linear combination of each set of variables to maximize the correlation between the sets (Tatsuoka 1971; Dillon and Goldstein 1984). Canonical correlation is appropriate when one is concerned with the linear relationship and shared variance between two *sets* of variables rather than the correlation between a pair of variables (as in bivariate correlation) or how well a collection of explanatory variables explains a single response variable (as in multiple regression). The linear combinations are referred to as canonical variables or canonical variates. The reported canonical correlation is the correlation between the two sets of variables within a canonical variate. A number of canonical variates are extracted, with each subsequent one being uncorrelated with the previous ones. In our case, there are two significant canonical correlations. The first canonical correlation is equal to .958, the second to .946 (both significant at $P < .01$), indicating considerable linear association between the network variables (i.e., our first set of variables) and the other context characteristics (i.e., our other set of variables). These high correlations suggest that the characteristics of village-level networks affect and are affected by village context.

¹⁰ Canonical correlation is a technique used with some frequency in psychology and geography; it is less common in sociology.

The canonical loadings provide more specific information about patterns of association between the network variables and village context variables. A canonical loading is the correlation between a variable and the canonical variate. Table 2 presents these loadings for the two canonical variates. In interpreting these loadings, we follow the common convention of focusing on values greater than .400 or less than $-.400$, which sets as a minimum for consideration a squared correlation of .16 or greater between the variable and the canonical variate for its set. The results in table 2 paint a picture consistent with processes that unfold as countries undergo the transition from being predominantly rural and agricultural to predominantly urban, focused on manufacturing and services.

Consider the first variate, focusing on those loadings that have an absolute value greater than .400. Among the network variables, three have an absolute value greater than .400. All involve the sibling network and point toward more cohesive sibling networks within villages and fewer ties outside the village. For the context variables, the loadings with an absolute value greater than .400 reflect villages that retain their residents (village size and proportion gone) and that provide employment opportunities when little labor is needed for growing rice (proportion growing cassava). The results of the canonical correlation analysis suggest that in a rural setting where out-migration is prevalent, the villages that have opportunities for retaining residents also have more cohesive sibling networks. And conversely, greater out-migration increases the permeability of village network boundaries. We now explain our reasoning.

Nang Rong district is a source of labor migration to Bangkok and the industrializing Eastern Seaboard. Greater participation of village residents in these migration streams should increase the permeability of village networks, and indeed, the percentage of the village population under 45 in 1984 no longer present in 1994 and the mean percentage of sibling ties outside the village in 1994 both load similarly (i.e., negatively) on the first variate. Out-migration also tends to be sex selective, with young men more likely to leave the village than young women (Curran et al. 2005; VanWey 2004). Thus, the positive loading of the village sex ratio, which will be higher when young men settle locally rather than leave, can be interpreted in the same terms. In addition, greater losses through migration are associated with looser sibling ties with villages. Ties inside and outside of the village may trade off. Clearly, village demography has consequences for village networks.

Alternatively, the loadings on the first canonical variate may indicate the importance of reverse effects. Context characteristics may be an outcome, in part, of village networks. Potential migrants living in more closely knit villages may be less likely to leave and more likely to return. Cohesion may act as an attractive force, and ties of obligation in the village may

TABLE 2
RESULTS OF A CANONICAL CORRELATION ANALYSIS

	CANONICAL VARIATES	
	First	Second
Canonical loadings for village network variables:		
Mean proportion reachable in paths of length 1, siblings	-.023	-.448 ^a
Mean proportion reachable in paths of length 1, rice help	-.272	.023
Mean percentage reachable in paths of any length, siblings .....	.470 ^a	-.495 ^a
Mean percentage reachable in paths of any length, rice help	-.092	-.086
Percentage isolates, siblings	-.618 ^a	.103
Percentage isolates, rice help .....	.069	-.099
Mean percentage of ties outside village, siblings	-.644 ^a	.518 ^a
Mean percentage of ties outside village, rice help	-.303	.638 ^a
Multiplexity, siblings, and rice help .....	.254	.283
Canonical loadings for selected village characteristics:		
Village size .....	.892 ^a	-.197
Average household size .....	.246	.146
Dependency ratio: children	-.170	-.472 ^a
Dependency ratio: elders	-.410 ^a	.147
Sex ratio .....	.465 ^a	-.369
Proportion gone	-.574 ^a	-.162
Proportion new .....	.221	-.277
Km to nearest village .....	.167	-.415 ^a
Rice suitability	-.240	.387
% growing rice .....	.014	.178
% growing cassava .....	.504 ^a	-.375
Average land used	-.016	.143
% using large tractor	-.051	.114
% using small tractor .....	.171	.249
% using pump	-.001	.449 ^a
Years since electrification .....	.062	.188
% 15-54 nonagricultural occupation	-.092	-.024
% 15+>primary education .....	.082	.378
% with televisions	-.141	.425 ^a
% with vehicles .....	.017	.431 ^a
% speaking Khmer	-.194	-.139
% speaking Lao	-.083	.143

^a Absolute value greater than .400.

counteract pulls in the destination. Young adults who stay may form new households, increasing the overall count. This may be why larger villages tend to have sibling networks that are more interlinked, with fewer ties to the outside, than smaller villages. The loadings on the first variate thus could come about in two quite different ways. Very likely, both processes are working, with ongoing feedbacks.

For the second canonical variate, loadings greater than .400 for the network variables point to less cohesive sibling networks and a greater proportion of ties outside of the village. Loadings for the context variables involve greater assets (water pumps, televisions, and vehicles), close proximity to another village, and having a low child dependency ratio. In rural settings where subsistence farming is common, the opportunity to acquire assets is related to household members migrating to places where they earn a cash income and then either send back remittances or bring funds home when they return (Adams 1991; Durand et al. 1996; Massey et al. 1987; Osili 2004; Richter et al. 1997), and migrating for work is easier if the village is near other villages and thus more likely linked together by bus routes. Either through their long-term implications for fertility (and hence, the size of sibsets) or their shorter-term association with migration patterns, the beginnings of a shift out of agriculture and the rise of consumer culture are negatively related to interconnectedness within villages and positively related to the percentage of sibling ties within villages.

The percentage of ties outside the village for rice help also loads on the second canonical variate. The extent to which help comes from outside the village is positively correlated with the proportion of households having televisions and owning vehicles. This may reflect the activities of migrants who return to help and who, through remittances, provide the resources to purchase productive assets and consumer items. It may also reflect a reorganization of the rice harvest, from one based on help provided among neighbors and family to one based on remunerated help recruited from other villages. Except for this one instance, however, the canonical variates refer to the properties of sibling networks, not patterns of help with the rice harvest.¹¹ Cross-sectional variability in the rice harvest network is not closely related to village context. This points to the importance of having multiple generators on network relations in a data set.

¹¹ As documented in the previous section, characteristics of the rice harvest networks do vary from village to village, and hence lack of variability does not account for the weak loadings of the rice harvest network variables on the canonical variates. Nor is nonlinearity an explanation. We examined scatterplots of each social network variable with each of the other village characteristics for evidence of nonlinearity and found none.

The results of the canonical correlation analysis can also be interpreted with respect to a more general, although admittedly fragmentary literature on networks and context. Consider village size first. There have been a number of studies comparing the size and composition of personal social support or discussion networks. Most of this work has been in industrialized Western countries, and has tended to focus on rural-urban distinctions. Notably, residents of urban or metropolitan areas have relatively fewer kin and more nonkin in their networks than do residents of small towns and rural areas (Fischer 1982; Marsden 1987; Beggs et al. 1996), though close kin remain important network members and providers of social support in all contexts (Hollinger and Haller 1990; Kasarda and Janowitz 1974; Wellman and Wortley 1990; Amato 1993; Litwak and Szelenyi 1969). Other evidence suggests that networks in relatively small places may be more cohesive, especially when ties are based in neighborhoods (e.g., among housewives) rather than in workplaces (Richardson, Erickson, and Nosanchuk 1979). People in nonurban settings are more likely to maintain ties with neighbors (Beggs et al. 1996; Thomese and van Tilburg 2000). Logic extended, we expected larger villages to be less cohesive, especially with respect to sibling ties. What we find is the reverse. This reverse finding is easily explained if village size is viewed as a consequence of the structure of social networks rather than cause (see discussion above). The literature on village, neighborhood, and community effects tends to view networks as intervening mechanisms, translating the effects of context. This need not be the case, however: networks may affect context as well as vice versa.

The positive connection between population turnover and the structure of sibling ties is more consistent with the literature. In contrast to the early expectations of Wirth (1938) that size and density were among the most influential characteristics of urban settings, more recent research has found that population turnover rather than size or population density is the important factor associated with lower friendship density and consequent lessening of social cohesion (Kasarda and Janowitz 1974; Sampson 1988, 1991; Freudenburg 1986). Community-level residential mobility has also been found to have a contextual effect on individuals' local social ties. People living in areas of high population turnover have fewer ties to the local area (Sampson 1988, 1991). Length of residence in the community is associated with more local contacts with friends, neighbors, and relatives (Kasarda and Janowitz 1974; Freudenburg 1986; Sampson 1988, 1991; Ishi-Kuntz and Seccombe 1989; South and Haynie 2004). Other investigations (e.g., Magdol 2000) find that geographic mobility is associated with spatial dispersion of members of a person's network. Population turnover, in the form of migration, also generates ties outside local

areas and facilitates flows of information and material goods, including remittances, from migrants.

Finally, sociologists have long been interested in how sweeping economic and social changes affect social relationships. In Western settings, there is considerable evidence that education and high SES increase the size and range of personal networks, diminishing their local quality (Marsden 1987; Fischer 1982; Campbell and Lee 1992; Guest and Wierzbicki 1999; Willert 2000; McPherson, Smith-Lovin, and Brashears 2006). The second canonical variate suggests a linkage between less network cohesion and a link to the broader, national culture (e.g., television, cars, motorcycles), most likely through prior migration. Given the cross-sectional nature of the data, we need to be cautious in our interpretation. That said, the pattern in table 2 is suggestive of a weakening of local ties and a strengthening of more distant ties that accompanies the incorporation of rural areas into a national economy and culture.

EXAMPLE OF A VILLAGE NETWORK EFFECT

Thus far, we have demonstrated that the properties of village networks vary, and further, that they covary in interpretable ways with features of village context. We now provide an example of the structure of village networks making a difference for an individual-level outcome. As we described above and displayed schematically in figure 1, this is ultimately how we judge whether a community or neighborhood effect matters. A characteristic of a neighborhood, village, or community may directly affect an individual-level outcome (path *a* in fig. 1) or it may affect the outcome indirectly through its effect on an individual-level variable (paths *b* and *c* in fig. 1). To demonstrate these different relationships, we undertake an illustrative analysis of the effects of the structure of sibling networks within villages on the likelihood of finding and interviewing a migrant from that village in the migrant follow-up survey. This is an important methodological concern in longitudinal survey research, and it is a theoretically and substantively important phenomenon, since it is based on accurate flows of information through a social system. We expect that among migrants reported to be in the top urban destinations, those coming from more cohesive villages are more likely to be interviewed in the migrant follow-up than those coming from less cohesive villages. Before discussing the results, we first describe the migrant follow-up data and then review the reasons for these expectations, which depend on information flow and norms encouraging survey participation.

Several surveys comprised the 1994 data collection in Nang Rong. In addition to the 1994 Household Survey described earlier, there was a

follow-up of migrants from 22 of the 51 study villages to the four most common destinations, all of which are urban areas: Bangkok, the Eastern Seaboard, Korat, and Buriram.¹² The whereabouts of all members of the household in 1984 were determined in the 1994 Household Survey. Anyone from one of the 22 selected villages reported to be living in one of the target urban destinations was eligible for the migrant follow-up. We focused here on former village residents whose home households reported them to be in one of these destinations.¹³ The 1994 Household Survey, the source of data for the village network variables, was fielded in April–June 1994, at which time migrant status was determined and information about migrant location collected. The 1994–95 Migrant Follow-up Survey began in August 1994 and continued until April 1995. The timing of the fieldwork is felicitous, with measures of social ties clearly prior to the outcome of interest, that is, whether migrants thought to be in the target destinations were found and interviewed (1 = yes; 0 = no).

Finding migrants very much depends on the information available to survey takers. Social ties are the conduits along which information flows—whether it be new or old, true or false (Rogers 1995). Social ties can be direct conduits of information through conversations and the like, or ties can pass along information second- or thirdhand. Although marginal group members may be best positioned for ready access to new information, once received, information spreads more quickly within cohesive groups (Granovetter 1983). Social network structure is fundamental to diffusion studies (e.g., Coleman, Katz, and Menzel 1957; Klovdahl 1985; Morris 1993). Our illustrative example is not a diffusion study, but the spread of information among villagers is very relevant to the ability of interviewers to track down and interview the migrants from each village. First, interconnectedness of social ties within a village should enhance the quality of information about migrant whereabouts. The greater the number of ties between households in the origin villages, the easier it is for news about migrants to travel back to origin households within those villages. It is probably also the case that an origin household that is itself connected to many other households will be better informed about migrant whereabouts, which increases the chances that interviewers will subsequently be able to find and interview them. We will consider this as well. Second, interconnectedness in an origin village may be mirrored by the

¹² The 1994 data collection also included a survey of all villages making up the district. The 1994 Community Survey is the source of some of the context variables used in the canonical correlation analysis. See appendix A.

¹³ The migrant follow-up survey attempted to contact all residents of the 22 villages in 1984 who were living in the target destination, regardless of where their origin household reported them to be, or even whether anyone from their origin household remained in the village to report on their whereabouts (Rindfuss et al. 2007).

destination-based social ties among the migrants from that village. If so, migrants will be easier to find. Interviewers can use these ties to track down the migrants. Indeed the migrant follow-up fieldwork was designed to take advantage of social ties in two ways. First, whenever a migrant was interviewed in one of the destinations, he or she would be shown a list of other migrants from that village and asked about the whereabouts of those on the list.¹⁴ Second, interviewers went back to the 22 origin villages during holiday times to interview migrants who were back visiting family and friends. Both approaches yielded successful interviews that would not have occurred otherwise.

Compliance is also important. Survey participation is a type of volunteer behavior, and the detail of the information disclosed as well as willingness to be interviewed at all is up to the participant. Finding migrants depends on the cooperation of the home household, other migrants, and the migrant himself or herself. Compliance can be considered from both a negative and positive perspective. In the United States and other developed countries, negative compliance, that is, refusing to be interviewed or stopping the interview in the middle, has been the main concern (e.g., Groves et al. 2002; Groves 2004). In developing countries, particularly in rural areas, it is not uncommon to find very high levels of participation. That has certainly been the case with the Nang Rong surveys, where participation in the rural villages has been essentially universal (Rindfuss et al. 2007), and refusals very unusual in the migrant follow-up phase of the fieldwork.

Positive compliance is a concept that has not received as much attention, but it can be important, especially in panel studies where locating those who move is always a challenge. To the extent that survey participation is a type of volunteer behavior, and to the extent that social norms are relevant to participating, then we might expect the structure of social ties to be relevant to the migrant follow-up for this reason as well as for the role it may play in information flow. In the origin villages, there is a choice to be made about how much information to disclose about the whereabouts of former residents. The more information provided, the easier it is to track down the migrants. The information depends on what members of the home households know, and it also depends on what they are willing to share. We expect that residents of more cohesive villages are more willing to share what they know. We expect that migrants from more cohesive villages might be more willing to cooperate as well, that is, more willing to provide locational information on other migrants. The structure of social ties affects norm enforcement and social influence more generally.

¹⁴ Interviewers recorded information about the migrants *not* already interviewed, as an aid to the conduct of the fieldwork.

This idea holds particular currency in the neighborhood effects literature, in its focus on neighborhood cohesion (Ross, Reynolds, and Geis 2000), collective efficacy (Sampson et al. 1999), and social capital (Lin et al. 2001; Putnam 1995). It is not as well developed in the village effects literature, possibly because the outcomes of interest in the neighborhood effects literature are so often “problem behaviors” of some sort, whereas in the village effects literature, the focus is more often innovation (e.g., Valente 1995).

For the purposes of the illustrative example, we focus on two measures of cohesion at the village level: the mean number of households reachable in the sibling network in a path of length one and the percentage of households that are isolates on the sibling relation. We control for the age, gender, and marital status of the migrant, well-documented characteristics of individuals that affect response rates in many cultures (Groves 2004; Groves et al. 2002) and that have proven relevant to the Nang Rong Migrant Follow-up Survey specifically (Rindfuss et al. 2007). We also control for village size (number of households); migration prevalence (proportion of the 1984 population under 45 years of age not present in 1994); the proportion of households engaged in cassava cultivation, a cash crop; the age structure of the village (a dependency ratio of those under 11 and over 54 to the population between those ages); and the percentage of households with water pumps, vehicles (motorcycles, itans, cars, trucks), and televisions. Results from the canonical correlation analysis (in the previous section) indicated a connection of these characteristics of villages and their cohesiveness on the sibling relationship.

Table 3 reports the estimated regression coefficients for five models assessing the consequences of village network structure for migrant follow-up. There are two pairs of models to assess the impact of a village-level social network measure with and without its household-level counterpart. These pairs address two interrelated questions: Does cohesion on the sibling network affect the likelihood of interviewing migrants from the village thought to be residing in target destinations? And if so, to what extent is this effect translated through sibling ties measured at the household level? If the answer to the first question is yes, there is evidence for the importance of village network structure. The answer to the second question sheds light on the mechanisms involved, and also the consequences of omitting a consideration of village network structure in an analysis of migrant follow-up. If the village measure has no effect after the household-level counterpart of that measure is included, then village cohesion is important as an antecedent condition, but omitting it from an analysis of migrant follow-up will not lead to bias if household ties are included. If cohesion remains important even when household ties are included, then there is a potential for bias if the village-level measure is

TABLE 3
 CONSEQUENCES OF COHESION ON THE SIBLING NETWORK IN THE ORIGIN VILLAGE
 (1994) FOR FINDING AND INTERVIEWING FORMER RESIDENTS OF THAT VILLAGE IN THE
 MIGRANT FOLLOW-UP, 1994–95: RESULTS OF A LOGISTIC REGRESSION ANALYSIS

	Model 1	Model 2	Model 3	Model 4	Model 5
Individual variables:					
Ages 10–14	-.292	-.303	-.311	.308	-.270
Ages 15–19 .....	.183	.191	.158	.159	.204
Ages 20–29 .....	.121	.128	.100	.102	.144
Ages 30+					
Male	-.209*	-.216*	-.214*	-.214*	-.199*
Married	-.676	-.675*	-.672*	-.671*	-.667*
Village variables:					
Size .....	.000	-.000	.000	.000	-.002
Dependency ratio:					
children	-1.689	-1.612	-1.445	-1.437	-.814
Proportion gone .....	.012	.013	.030	.030	-.002
% growing cassava	-.011	-.011	-.017*	-.017*	-.006
% with pumps .....	.003	.005	.014	.014	-.002
% with vehicles	-.009	-.009	-.001	-.001	-.014
% with televisions .....	.014	.014	.009	.009	.014
Social networks:					
Village					
Mean % reachable in path length					
1	46.722*	38.060			
% households that are isolates			-3.857*	-3.816*	
Household					
No. reachable in path length 1 .....		.096*			
Whether an isolate				-.034	
Constant	-.131	-.107	.530	.537	1.136

NOTE—The analysis is based on 2,486 1984 residents of 22 villages in Nang Rong, Thailand, reported to be living in Bangkok, the Eastern Seaboard, Korat, or Buriram City in 1994 by their home households. The dependent variable is binary, where 1 means the migrant was found and interviewed in the 1994–95 follow-up, 0 otherwise.

* $P < .05$, after corrections to the SEs for clustering in the data.

not included in the analysis. There is one more model in the table, one that excludes all of the social network variable that serves as a baseline for comparison.

Models 1 and 2 focus on the effect of the mean number of households reachable in a village’s sibling network in a path of length one. The positive, statistically significant coefficient for this variable in model 1 shows that village cohesion in the sibling network enhances the likelihood of interviewing a migrant from the village. Model 2 adds the number of

households that can be reached in a path of length one for individual households to model 1. This variable has a significant positive effect. Migrants from households linked directly through sibling ties to a larger number of other households in the village are more likely to be interviewed. When the household counterpart of the village-level network variable is added, the effect of the village-level network variable is reduced in size and is no longer statistically significant, suggesting that in this instance, the impact of the village-level network variable is translated through its household-level counterpart. A household's direct ties to other households in the village increase the chances of finding and interviewing former residents. The average number of these ties at the village level does not contribute much beyond the ties the household has on its own.

Models 3 and 4 focus on the effect of the percentage of households in the village that are isolates in the sibling network. The negative and statistically significant coefficient for this variable indicates that the follow-up of migrants from villages with a greater percentage of such households was less successful. Former residents of less cohesive villages are less likely to be found and interviewed, a result consistent with those already discussed. Interestingly, in model 4, whether or not a household is an isolate in the sibling network has no effect on the likelihood that former members of that household are found and interviewed. Comparing the results of model 4 with model 3 shows that the effect of the village-level measure of cohesion is not changed by the addition of its household-level counterpart. There is an effect of the percentage of households that are isolated in the sibling network that exists whether or not the household in question is itself isolated in this network.

Model 5 in table 3 does not include any social network variables. A comparison of the results from this model and those from the other models shows the other determinants of follow-up to be fairly stable and not very sensitive to the inclusion of the social network variables. With respect to the migrant follow-up, the structure of sibling networks does not account for or explain the impact of other village characteristics. If this were the case, we would see a weakening of the effects of these other characteristics when the network variables are included. This does not occur. In fact, none of the village variables are significant in model 5. Only one of these variables is ever significant in any of the models: the proportion of households growing cassava. Remember, however, only migrants from 22 villages were interviewed in the migrant follow-up, which puts restrictions on what might be found in the way of village effects. Nevertheless, in this illustrative example, the effects of social network structure are not contained within the effects of other village variables.

This example demonstrates the importance of the structure of social networks at the village level to an individual-level outcome, the likelihood

of interviewing migrants. Migrants from more cohesive villages are more likely to be interviewed than those from less cohesive villages. The results are agnostic as to whether this effect operates through the social ties of the origin household or some other mechanism—it depends on the measure of cohesion used. Further research on these mechanisms is warranted. For instance, one could examine the level of detail in the information provided by home households. Cohesion should positively affect the level of detail by enhancing the flow of information within the village. Does the cohesion of the origin village have an effect on the success of the follow-up even after controlling for the level of detail in the information provided by the home household? This would suggest that social networks in the village have implications for ties among the migrants from that village. A complete explication of the role of social networks in the migrant follow-up would consider a full range of network properties, a variety of different social relations out of which networks might be constructed, and a variety of mechanisms through which they might operate. The goal of the illustrative example was simply to show that the structure of village networks matters for an individual-level outcome, a goal that has been accomplished.

DISCUSSION AND CONCLUSION

This article has taken a three-pronged approach to investigate how social processes explain contextual influences, as are commonly found in studies of neighborhood or community effects. We build on two distinct, yet complementary, conceptions of social structure—one based on networks of ties among individuals or collections of individuals, and the other pertaining to the contexts containing these individuals or collections. We argue that this distinction is crucial for understanding exactly how social processes translate into contextual effects. Moreover, we argue that it is important to recognize that contextual effects can operate both directly through a contextual variable and indirectly through its individual-level counterpart (Blau 1960), and that relationships between network and context might be reciprocal.

Our analysis proceeded in three stages. First, we demonstrated considerable variability in the network structure of rural villages. We then showed that this variability was associated in interpretable ways with other features of village context. Finally, an illustrative example revealed that covariability of network and context had consequences for an individual-level outcome, but that contextual effects operate in different ways. We now discuss the more general implications of these findings in greater detail.

First, our results demonstrate substantial variability in the network structure of rural villages in Nang Rong, Thailand. Villages may have never fit a stereotype of uniformity, but for sure, Nang Rong villages do not fit it today. Moreover, villages are not self-contained. Boundaries are permeable, and social ties extend beyond administrative units. The structure of social relations varies across villages. Networks are sparse in some, dense in others; porous in some, less so in others. Moreover, this variability matters. The Nang Rong surveys are unusual in having collected complete multirelational social network data in all of the villages. Because of design demands and also expense, such data are very rarely collected. It is therefore important to draw out the lessons that can be learned from the analysis of the Nang Rong data.

Variability among the 51 villages in our Nang Rong sample carries a clear message for researchers doing case studies of single communities or settings, a practice common in social network research. Our results indicate that even in a region where initially we might not have expected substantial variability among villages in the structure of kin and economic networks, in fact, we find substantial variability. Had we simply studied one village as “typical” of Nang Rong, we would have had a very limited, and possibly misleading, picture. The degree of variation we see among villages in Nang Rong is probably not unusual. Villages in other parts of the country, and communities and neighborhoods in other parts of the world, likely show considerable variability. Our results thus bring into question conclusions based on case studies of a network in a single setting, be it a village, neighborhood, classroom, or organization.

Variability in the structure of social networks provides a social structural basis for understanding contextual effects. Studies of contextual effects in rural villages of developing countries, and neighborhoods in the urbanized parts of all countries, presume diversity. Just as villages differed in network structure, there also is considerable variability in the demographic and social characteristics of members. While it was known that neighborhoods and communities vary in their location, demographic characteristics, economic organization, and so forth, before now, little was known about variability in the structure of locally based social networks, and virtually nothing was known about the degree of covariability among features of networks and contexts. Not only has this article documented substantial variability in the structure of social networks, but the canonical correlation analysis has shown covariability in the characteristics of networks and contexts. Villages that are more cohesive with respect to sibling ties, and with fewer ties outside the village, also tend to be larger villages, with lower out-migration rates, able to attract or retain males, and with a greater involvement in cassava cultivation. Villages located in more densely settled areas, with lower recent fertility, and a greater

level of affluence, are less cohesive internally and are more closely tied to other places than other villages. These patterns of covariability among networks and contexts are consistent with more general insights into the association between sweeping social and economic changes and patterns of social relationships.

The literature on neighborhood and community effects posits social ties as a mechanism for the effects of context. Thus a correlation between measures of network and context is expected, and the fact that we find it can be seen as support for the theory. However, our results are also consistent with reverse effects, that is, that networks have consequences for contexts. Sorting out cause and effect between networks and contexts more generally will be difficult, and it is likely that changes in contexts and networks feed back upon each other in an ongoing manner.

Patterns of variability and covariability of networks and contexts at the neighborhood, community, or village level will be no more than a curiosity if they cannot be shown to have consequences for choices and behaviors. The purpose of the illustrative example, as the third prong of our empirical analysis, was to show that social cohesion, as reflected in the structure of sibling networks in the village, affected the likelihood of finding and interviewing migrants, an outcome measured at the individual level. There is a large literature addressing the effects of social networks on migration, especially social networks in places of destination (e.g., Bastida 2001; Coleman 1988, 1990; Curran et al. 2005; Korinek, Entwisle, and Jampaklay 2005; Massey et al. 1994; Palloni et al. 2001). Our illustrative example shows that social networks are also important for which migrants we find, and therefore to what can be learned about the migration process. This result has substantive and theoretical as well as methodological implications. The effects of cohesion may operate through the social ties of home households, or they might have an effect “above and beyond” the effects of these social ties—our illustrative example provides evidence of both. It is important to emphasize that, either way, the cohesion of origin villages has an effect. Sometimes in studies of neighborhood or community effects, investigators interpret the absence of an effect of a neighborhood or community variable in the presence of controls for individual and household variables as the absence of a neighborhood effect altogether. If the neighborhood or community variables operate through variables measured at the individual or household level, the absence of a direct effect in the presence of controls for these other variables says nothing about whether or not local contexts make a difference.

While not generalizable in their specifics, the findings from the illustrative example caution us about assessments of neighborhood and community effects in other settings. Social networks may operate as a mechanism through which other characteristics of local contexts exert their

influence, but network structure may also affect these other characteristics. Certainly, it would be rash to assume that because social networks serve as a potential mechanism for other neighborhood and community effects, that they are somehow contained within these other effects. Further, it would be inadvisable to assume that social ties measured at the individual or household level reflect the effects of social network structure at other levels of social organization. In our illustrative example, one measure of village cohesion was translated by its household counterpart, but the other was not. Untested assumptions about how these effects work are risky at best.

APPENDIX A

Measures of Village Context: Definitions, Sources, Descriptive Statistics

Measures of village context draw on a variety of sources: 1994 Nang Rong Household Survey, 1984 Nang Rong Household Survey, 1994 Nang Rong Community Survey, and a set of geographic information system (GIS) coverages. For more information, see <http://www.cpc.unc.edu/projects/nangrong>. All measures refer to 1994.

Village size is the total number of households in the village. Average household size is the ratio of the total number of village residents to the total number of households. The dependency ratio for children divides the total number of residents under 11 years of age by the total ages 11–54. The dependency ratio for elders divides the total number of residents 55 and older by the total ages 11–54. The sex ratio divides the total number of males by the total number of females and multiplies the result by 100. All of these variables were obtained by aggregating data collected in the 1994 Household Survey.

The percentage gone is the number of village residents under age 45 in 1984 who were no longer resident in the village in 1994, divided by the total number of village residents under age 45 in 1984, multiplied by 100. Nang Rong is a source of migration to Bangkok and to the Eastern Seaboard, as well as to nearby rural areas. The percentage new is the number of village residents ages 11–54 in 1994 who were not resident in the village in 1984, divided by the total number of village residents ages 11–54 in 1994, multiplied by 100. These variables were formed by linking the 1984 and 1994 Household Surveys and then aggregating to create village-level measures.

Measures of village location and suitability for rice are derived from a GIS for the district. Kilometers to the nearest village was calculated from a coverage locating all villages in the district (and within a 10 km buffer surrounding the district). Suitability for rice is measured as the percentage

of land within a 3 km buffer around the village center that is alluvial plain or low terrace (best for paddy rice production, the main crop grown in Nang Rong).

The percentage of households growing rice and cassava, the average amount of land used, and the percentage of households using large tractors, small tractors, and pumps is obtained from reports of land and land use in the 1994 Household Survey, which are aggregated, divided by the total number of households in the village, and multiplied by 100. An “itan” is a very small truck with an engine that can be easily removed and used for other purposes, for example, as a water pump.

Years since electrification was determined based on reports in the 1994 Community Survey.

The percentage of persons ages 15–54 with a nonagricultural occupation was determined based on reports about household members in the 1994 Household Survey, aggregated, and then divided by the total number of persons ages 15–54 resident in the village at that time and multiplied by 100. The percentage of persons ages 15 or higher with more than a primary education was created analogously.

The percentage of households owning a television or vehicle (motorcycle, car, truck, itan) was created from reports in the 1994 Household Survey, aggregated, divided by the total number of households, and multiplied by 100.

The percentage of households speaking Khmer or Lao—both minority languages in the Nang Rong context—was created analogously. Culturally, Nang Rong is fairly homogeneous. Residents are Buddhist, and temples are in or near villages. There are several dialects that are spoken in the villages, however. The main language is a version of Thai, either Korat Thai or Isaan Thai, but Lao and Khmer are also spoken in some places. There are historical reasons for these differences. For one thing, the Northeast of Thailand was once part of the Khmer empire (Rooney 1999). A few of the villages in Nang Rong district are several hundred years old and may date back to this period. In addition, more recent settlers moving into Nang Rong included some from Cambodia and Laos.

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