Community or Connections?
A Social Networks Approach to Chain Migration

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Abstract

This paper introduces a social networks approach to specifying and measuring the process of chain migration. Using a unique combination of survey and vital registration data for the Matlab Subdistrict of Bangladesh, I construct measures of past migrant stock that are specific to household lineage and residential compound groups, and to social networks that share historical links to those groups. Regression models predict the hazard of subsequent urban-rural and international migration in terms of migrant stock for these newly specified networks alongside effects for the village and household. Migrant stock for residential compound and social networks are strong predictors of the hazard of migration, particularly of rural-urban migration, explaining away about 50% of the village migrant stock effect. The demonstrate the potential value of social network-based measures of social capital, the extraordinary benefits of using Demographic Surveillance System data for migration research, and concerns regarding a village-based specification of migration-specific social capital.

I. Introduction

Some of the most compelling results to emerge from recent migration research have come in explaining chain migration, the tendency for past migration to be strongly associated with further migration. Although we can observe this process unfolding as people from a single nation, region, and even community come to dominate certain industries in migrant destination areas, only recently have we developed detailed testable, theoretical hypotheses regarding chain migration.

Chain migration unfolds as the costs and risks of migration decline or the returns to migration increase for members of a contextual unit, such as a community. Among other things, we have learned to conceive of migration as a social diffusion process whereby low status households initially not migrating will eventually gain access to migration and all of its benefits (Durand, Massey, and Zenteno 2001). Information and opportunities relating to migration become institutionalized as a form of "migration-specific social capital" potentially benefiting the entire community (Massey, Goldring, and Durand 1994; Massey et al. 1987). The penetration of migration opportunities throughout the socioeconomic distribution of a community or society is one critical element for anticipating migration's ultimate impact on socioeconomic stratification and its impact on the welfare of the poorest households. While this perspective is particularly constructive for seeing how receiving societies interpret the growth of migration from a single sending society, region, or even community, it may offer only a partial understanding of the process form the sending community perspective.

Treating chain migration as a process of transmission of contextual social capital overlooks the possibility that migration opportunities are not common assets available to all who wish to use them, but scarce commodities. While migration opportunities may not be sold on the open market, they may be allocated with extreme preference: to members of a community with a shared lineal or social history, and to members of a community with resources to offer in explicit or implicit exchange. Furthermore, some members of a community with a limited migration experience may have substantial ties to past migrants from other communities. Extra-community ties, not captured by contextual measures of migrant stock, help explain how migration opportunities are transmitted from community to community. These two concerns are not unrelated: if low status households in a high-migration community do not provide a suitable match for a migration-specific social network, these opportunities may instead pass to high status households in low-migration communities.

This paper serves as a first step in beginning to address the extent to which the process of chain migration reflects a contextual or a conditional process. Taking advantage of the unique historical demographic detail of the Matlab Health and Demographic Surveillance System (MHDSS), I predict the hazard of rural-urban and international migration using contextual measures of migrant stock as well as network-based measures. Household are linked in *primary lineage networks* according to a shared history of coresidence in family and compound units. Primary lineage networks are then linked to one another through histories of inter-marriage and internal migration to generate *peer networks*.

The following two sections present potential explanations for chain migration in greater detail and draw on previous qualitative research to stress the importance of chain migration in the context of rural Bangladesh. The fourth section describes the survey and surveillance data used in the study and offers extensive detail on the construction of peer networks and the estimation of migrant stock. Finally, contextual and peer networks data are used to predict the hazard of rural-urban and international migration among a sample of adults males in Matlab from 1996 to 2002.

II. Contextual Relationships between Past and Future Migration

Past research has observed the association between higher levels of past migration and higher levels of subsequent migration at the household, community, regional, and national level (Massey 1990; Massey and Espinosa 1997; Wegge 1998; Massey et al. 1999). Studies have typically predicted the likelihood of migration in terms of the accumulated migration experience ("migrant stock") among family units and among contextual units such as communities (Munshi 2003; Zhao 2003). The proximate effects leading from past migration to subsequent migration include lowering moving costs (Carrington, Detragiache, and Vishwanath 1996; Wegge 1998; Shah and Menon 1999); increasing the chances of permanent employment and expected wages (Taylor 1986; Greenwell, Valdez, and DaVanzo 1997; Shah and Menon 2000; Sanders, Nee, and Sernau 2002; Aguilera and Massey 2003; Aguilera 2003); and enhancing socialization and adaptation in the destination area (Sanders et al. 2002; Menjivar 2002).

Both structural and social mechanisms can explain these proximate effects. Structural mechanisms underlying chain migration reflect accumulated changes to local markets, infrastructure, culture, or knowledge that would permanently change the calculus of the migration decision (Massey 1990).[1] For example, high demand for transport between origin and destination areas may lead to improvements in transport infrastructure that reduce the costs of moving for future migrants. As individual changes accumulate, migration may engender a "culture of migration" whereby life is increasingly oriented around the eventual practice of

[1] For a more detailed treatment of structural factors underlying chain migration, see Massey (1990).

migration (Kandel and Massey 2002). Empirical models have captured the structural effects of migration either by controlling for contextual measures of migrant stock or by controlling for specific changes to the context (Lindstrom and Lauster 2001; Shah and Menon 1999).

The social effects underlying chain migration stem from the contacts that members of a sending community maintain with current and returned migrants (Espinosa and Massey 1997; Lindstrom and Lauster 2001; Shah and Menon 2000). In this respect, chain migration bears characteristics of a process of social diffusion (Massey et al. 1987; Van der Gaag and Van Wissen 2002). Early movers tend to come from the highest strata of a community, as household wealth may buffer prospective migrants against the costs and risks associated with moving (Taylor 1986; Waldorf 1996; Massey et al. 1999; Sanders et al. 2002). Over time, social networks should reduce the costs and risks of migration for an increasing share of the population, and to an increasingly representative cross-section of the community (Winters, de Janvry, and Sadoulet 2001; Zhao 2003).

As the number of individuals in a local area network having knowledge, experience, or authority in a specific destination area increases and reaches a critical density, individual social connections can be converted into a form of migration-specific social capital based on shared community or ethnic origins (Ebaugh 2000; Winters et al. 2001; Elmhirst 2002; Davis, Stecklov, and Winters 2002; Hagan and Ebaugh 2003). For example, Kuhn's (2003) qualitative analysis of migration in Bangladesh demonstrates how community-based identities that had no currency in a strictly-local context can serve as entrees into migration and employment opportunities as the density of people from the same rural Bangladeshi communities living in Dhaka, the capital, increased. This and other research provide a compelling reason to treat migration-specific social capital as a contextual characteristic, to be measured in the same fashion as structural effects (Wilson 1998).

Yet more recently, considerable concern has been expressed over simplifying social capital to a contextual concept whereby all members of the community draw equal benefit (Portes 1997, 2000; Krissman 2005). Ignoring, for the moment, the possibility that social capital can have negative implications, concerns have been raised about the presence of social exclusion and conditionality in social networks, particularly those that ascribe a particular and potentially lucrative opportunity such as migration (Burt 1998, 2000; Wejnert 2002; Krishna 2004). Contextual measures of social capital may ignore the explicit exclusion of certain subgroups in a community from the channels of social capital (Winters et al. 2002; Krishna 2004; Das 2004).

Some have sought to address the role of exclusion in networks of socially-transmitted opportunity by explicitly disaggregating networks according to observed and acknowledge social cleavages (Curran and Rivero-Fuentes 2003; Davis and Winters 2001; Silvey and Elmhirst 2003). This approach has proven quite effective for separating communities along discrete, easily differentiated groupings such as gender and ethnicity. It cannot address the unobserved or continuous patterns of social exclusion characterizing social lineage, social class, and social peer relationships in rural communities. Some members of a community will have much larger social networks, and some networks will have a higher proportion of experienced individuals (Portes 1998; Strang and Soule 1998; Winters et al. 2001). Some of this variation should be random, but some of it should be systematic. If high status households move first, then those with ties to high status households will also have stronger ties to past migrants. The size, status, and migration experience of a social network should be correlated positively with a constellation of other measures of socioeconomic status. Contextual measures of migration-specific social capital offer no potential for households in a community to vary on any of these social network dimensions.

A few papers have addressed the importance of weak and strong ties in chain migration, but most have focused on differences between family networks and community networks that are specified contextually (Wilson 1998; Winters et al. 2001; Collyer 2005). Yet one critical factor in the transmission of migration opportunities *between communities* may be the strength of connection to social peers living outside the community of origin. Among communities with low levels of migration-specific social capital, contextual measures of migrant stock offer no potential to discriminate among households in a community having strong migration-specific social ties outside the community, and those that don't. Yet our accumulated knowledge on the strength of weak ties suggests it is far more likely for the earliest migrants in a community to be influenced by past migrants from other, more experienced communities than for them to move without any social impetus at all.

III. Research Context

Migration to cities and other countries has become central to the economy of rural areas of Bangladesh such as the Matlab *Upazila* study area.[2] Matlab is a rural subdistrict located about 55 kilometers southeast of the capital city, Dhaka. Like most districts of rural Bangladesh, the traditional basis of economic life is a single monsoon-fed rice crop although recent water management projects have created opportunity for more extensive cropping in some areas. The monsoon and persistent limitations to production technology and liquidity management leave

[2] *Upazila*, the lowest level of government, is comparable in size to a US county. It is also referred to as *thana,* which means literally "police stand".

households exposed to extreme seasonality in commodity supply, prices, and nutrition, as well as persistent risk of economic failure.

While some of these deficiencies can be addressed by seasonal migration to richer rice-producing regions of the country, a far more common and lucrative remedy is migration to an urban or overseas destination. Although distance to the capital is short, travel time is six hours by boat or bus, depending on the season, necessitating rural-urban migration rather than commuting. Close proximity does facilitate a pattern of frequent urban-rural circulation, solo migration by adult males both single and married, and a constant flow of information and opportunity between destination cities and origin villages. International migration is also quite common in the study area, most frequently to India (primarily among the Hindu population, 12% of the sample) and to oil-rich countries in the Persian Gulf, particularly the Kingdom of Saudi Arabia. International migration was practiced almost exclusively by males.

Previous qualitative research on social networks and rural-urban migration from Matlab has addressed the structure and function of the origin-area social networks critical to gaining access to rural-urban migration opportunities. The study highlights the role not merely of residence, but of specific ties accessed through a shared lineal history or functional economic linkages to past migrants, particularly to powerful migrant "gatekeepers", such as business owners and civil servants, responsible for bringing large numbers of migrants to the city. This work also highlights the importance of marital alliances in the transmission of migration opportunities. Marriages, which are typically extra-local, provide a powerful social linkage between communities that would necessitate migrant stock measures that are not village-based. Marital ties transmit migration opportunities from high-migration communities to low-migration ones, bypassing members of high-migration communities that may not be willing or able to participate in chain migration networks.

IV. Study Data

The analysis of migration-specific peer networks in Matlab takes advantage of a unique combination of survey and surveillance data. The Matlab Health and Demographic Surveillance System (HDSS) has computerized demographic histories for approximately 40,000 households in 149 villages since 1966. This study takes advantage of data spanning 1974 to 2002. The system gathers dates and basic information on every birth, death, marriage, divorce, and migration. Migration surveillance captures all moves of more than six months in length, with separate files for moves outside and within the boundaries of the HDSS area.

Unique identifiers for individuals, households, *baris* (residential compounds), and villages facilitate the construction of primary and peer networks for the analysis. Censuses conducted in 1982 and 1993 facilitate tracking of household partition and the creation of a household lineage identifier for use in lieu of a current household identifier. HDSS also provided the sampling frame for the Matlab Health and Socioeconomic Survey (MHSS), which provides the baseline sample for the current study. See the section on "building the dataset" below for further detail on MHSS and units of analysis.

It may be helpful to the reader to keep in mind some of the advantages and disadvantages of using HDSS data to study migration, and to consider the likelihood of recreating some of its advantages in the context of survey data collection. HDSS data are valuable for facilitating prospective modeling of vital events. Large sample size facilitates the modeling of rare events. Relatively common events such as migration can be disaggregated into specific events like rural-urban and international migration. Although migration is relatively rare in any given year, we can still conduct stable hazard models of migration without sampling on the dependent variable, as in the case of ethnosurveys, the typical approach to studying migration.

The advantages most salient to this paper stem from the accumulation of prospectively-gathered historical background data on the study population. HDSS data provide precise migration histories for all individuals in the study population up to the point they leave the study area and upon their return. Furthermore, we can aggregate migration and other vital events from individual level to higher levels such as the household, the residential compound, and the village. Aggregate vital event data of this form mirror the contextual measures of migration-specific social capital used in previous studies, but with several added advantages. Prospective data collection gives greater precision on the timing and characteristics of vital events. It also facilitates well-defined identification of contextual units, and frequent updating of changes to membership in contextual units. Finally, HDSS data provide 100% coverage of all events occurring in the contextual units with little possibility of bias.

The key benefit of HDSS data for this study is the opportunity to identify direct, non-contextual linkages between individuals or households that are not explicit to the data framework. Namely, this study will construct peer networks from histories of inter-marriage and internal movement between households. For a number of reasons, this approach is highly experimental. First, and most obviously, no study has ever constructed peer networks from HDSS data. Second, prior peer network studies have identified linkages directly through nominations; this study uses only the indirect links available on hand.

The use of inter-marriage and internal migration histories can be justified on grounds other than convenience. Studies of migration in Bangladesh and elsewhere in the Indian Subcontinent have demonstrated their role as both a result of and a foundation for strategic arrangements among households. In particular, Rosenzweig and Stark (1989) demonstrate the importance of marriage in cementing cooperative linkages. Other internal migration arrangements, including child fostering and transitional living arrangements, all fit into a framework of cooperation linkage between households.

HDSS data also suffer a number of key limitations, mostly relating to the circumscribed spatial area covered by each system. First, data on a small spatial area will not be equipped to capture much of the contextual variation resulting from structural factors such as global capital penetration, regional political differences, infrastructural differences, language, and ethnicity. As a result, this study should yield substantially smaller contextual variation than nationally-representative studies. Second, migrant stock and peer network data are left-censored at the year 1974. Most other studies of chain migration, while prone to retrospective recall bias, cover all previous migration episodes. In this case, migrant stock for the 22 years following 1974 must proxy for migrant stock prior to 1974. For individual and household migration behavior, survey data will provide information on episodes prior to 1974.

A final concern specific to this paper is that peer networks are formed not from open responses, but from longitudinal records circumscribed to the HDSS area. This presents a boundary problem relating to a respondent's positioning within the study area. Villages living at the center of the HDSS area are likely to have a higher proportion of their marriages or internal moves within the HDSS area than households living on the edges of the HDSS area. This should lead to systematic variation in the size of peer networks and in the sample size (and thus error) of migration rates within the peer network. It should not lead to bias in estimating peer network migrant stocks so long as the HDSS area boundaries do not correspond to any obvious barriers to social interaction.

V. Building the Dataset

Table 1 outlines the steps involved in creating the data for this study. The description emphasizes a careful and transparent description of the steps necessary to construct peer networks and measures of migrant stock for all units of analysis. Table 1 identifies these units. The analysis looks at two units commonly employed in the chain migration literature: the survey household and the village. It also identifies each respondent with two primary social networks, the household lineage and the *bari.* The use of the term primary network implies both that HDSS identifies these linkages directly and that they correspond more of less to social groupings of recognized importance within Bangladeshi society. Finally, peer networks are constructed for the household lineage and *bari.* In contrast with primary networks, peer networks neither correspond to any established social order nor are they identified directly by the DSS database.

[INSERT TABLE 1 ABOUT HERE]

Step 1: Identification of baseline study sample

The baseline population consists of all adult males, age 15 to 49, residing in households included in the Matlab Health and Socioeconomic Survey (MHSS), a survey conducted in Matlab in 1996 by ICDDR,B, RAND, Harvard School of Public Health, and the University of Pennsylvania. The primary sample consists of a two-stage random sample of 4,364 households in the 37,500 household HDSS study area.[3] Household rosters gathered basic demographic and socioeconomic data on each household member. The household head responded to a detailed module on the

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3 The first stage was a random selection of baris. The second stage selected one household from the bari at random, and a second household purposively with priority to fathers, children, and brothers of the head of the first household. If no such household was present the second household was chosen at random. All analyses incorporate sampling weights to account for the likelihood that any given household in the sample was interviewed. An HDSS census of households and baris, conducted in 1996, enabled the construction of highly precise weights.

economic activities of the household and each member. An adult survey module gathered detailed data on health, economic activities, and demographic history. The adult module was only administered to a complex selection of household members, resulting in only 66% of males age 15-49 being interviewed.[4] To take advantage of as many cases as possible, this analysis includes all males age 15-49 rather than just those who responded to the individual adult survey. While this limits the availability of highly detailed control variables, the rosters and household economic survey should provide ample statistical control for the purposes of this analysis.

Step 2: Identification of Primary Social/Administrate Units

The second step in the data exercise entails identifying the primary units of analysis for the construction of migrant stock data. First, we look at the traditional units of analysis. MHSS identifies each respondent with his ***survey household***. As in many other studies, the household is uniquely defined as a group of individuals that eat from the same cooking pot, even though they may lodge in separate dwellings. HDSS data identify the ***study village***, which corresponds to the *mouza,* an administrative unit that may include several neighborhoods.[5] HDSS identified 149 villages in 1974, of which 141 remained after substantial flooding and river erosion in the 1980's.

The first primary network unit drawn from the HDSS data is the ***household lineage***. While individual survey households typically include a single nuclear family, HDSS records of household splits occurring between 1974 and 1996 can identify the household from which the current MHSS household emerged as of 1974. Distinct MHSS households can thus be joined to a

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[4] Selection proceeded as follows: head and spouse of head, members age 50+ and spouses, and two additional randomly-selected adults age 15-49.
[5] To identify MHSS respondents with their villages and with all subsequent HDSS identifiers and peer networks, MHSS data were linked to the privacy-protected, secure version of MHSS.

smaller number of lineages that reflect long-term social ties. In most cases, household splits trace the fission of patrilineal families as sons separate from fathers, and brothers from brothers. Identifying households that were part of the same household in 1974 is therefore principally a way of identifying cousins. Household that had not split since 1974 formed no linkages, and stood alone as the only household in their lineage.[6]

HDSS tracks each household's membership in one further social grouping, the ***bari***. *Baris* are residential compounds or courtyards that form the locus of household production and ritual. *Baris* are a spatial grouping, similar to a residential block in an urban context. The social function of the bari varies from district to district, but in Matlab they typically reflect a shared lineage, such as descendants of a single grandfather or great-grandfather. HDSS initially identified *baris* in order to address the possibility that the arbitrary definition of a household could not fully capture patrilineal social organization in the study area. Evidence from the MHSS, which was designed to address the meaning and function of the *bari*, suggests substantial pooling of socioeconomic risk among households in the same *bari* (Foster 2005; Joshi and Sinha 2005). HDSS updated *bari* identifiers in in the 1993 census.

Step 3: Peer Network Construction

The next step in the process involves the construction of peer networks joining respondents to household lineages and *baris* that have historic connections to their own. While few data sources provide data on the explicit linkages among members of such a large population, HDSS marriages and internal migration histories provide a proxy for peer linkages. In general, these

[6] For the most part, household splits in rural Bangladesh involve the formation of a new household in close proximity to the original household. If a household split and the new household moved to a distinct spatial area, the two households would not share a household lineage. Their relationship would, however, be picked up by the peer network linkag

events draw a history of social linkage between household lineages and *baris*. More specifically, marriages, which typically involve mates from separate *baris* or villages, often involve the transmission of migration opportunities, particularly from villages with high migrant stock to those with low stock (Kuhn 2003).

First-order peer linkages, or directly linkages between two units, are formed from a combination of internal migration and marriage data because internal migration data are available only as far back as 1982. For the June 1982- December 1996, peer linkages are formed using internal migration data, which include all marriages as well as a number of less common internal movements.[7] For June 1974 to June 1982, peer linkages result only from marriages.

A first-order peer linkage is assigned for each internal migration or marriage *episode* linking two household lineages or *bari*, capturing the strength of association between two units. Rare cases in which multiple individuals moved between units in the same episode resulted in only one linkage. The current dataset does not account for the timing of the formation of the peer linkage, either with respect to the absolute timing of their linkage or to the relative timing in relation to the external migration episodes that contribute to the stock measures. These concerns provide fertile ground for future studies. Linkages formed between two survey households from the same household linage or *bari* are not counted. Primary networks already capture these linkages, and doing so would merely link units to themselves.

Second-order peer linkages are formed by merging the list of first-order peers to itself, creating a list of peers' peers. Second-order networks reflect a nexus of shares ties that may be critical to the relaying of information and opportunity. In particular, second-order peer network measures should "compete" with contextual village-level measures as a possible indicator of the

[7] These include household relocation, movement of elders from sibling to sibling, and movement of children to live with relatives living in closer proximity to school

transmission of migration through cultural or identity-based pathways. In other words, do identity-based or community-based migration opportunities reflect a pattern of solidarity among those of shared community origin, or those who share loose social linkages?

Because linking episodes were used to draw first-order peer linkages, two units can share any number of first- and second-order linkages. As with first-order linkages, you cannot be your own peer's peer. Second-order linkages that run from your unit, to another unit, and back to your own unit, even to a different survey household than your own, are not counted since they are captured by primary network linkages.

Table 2 summarizes network size and migrant stock for each reference group. As suggested above, primary household linage networks contain a substantially more males than the survey household itself. Also, primary *bari* networks are substantially larger than primary household lineage networks. As the number of network linkages increases exponentially with each higher order linkage, and the number of males increases proportionately, *bari* peer networks grow increasingly larger. The mean size of a second-order *bari* peer network is substantially larger than the mean size of a village.

[INSERT TABLE 2 ABOUT HERE]

There is considerable variability in primary and peer network size, particularly for second-order networks. A substantial proportion of networks include no males, even among the fairly large first-order *bari* networks. Since peer linkages are constructed recursively, households with no primary *bari* links also have no peer links.

Step 5: Construction of Migrant History Files

Migration history or migrant stock data come from HDSS out-migration records for the period from June 1974 to December 1996. HDSS out-migration files record all movements out of the study area of six months of greater. The migrant stock file include only moves made by men aged 15 to 49 at the time of the move. Destination codes identify moves to urban destinations within Bangladesh (rural-urban migration) and overseas destinations (international migration). This study does not address moves to other destinations outside the HDSS area but inside Bangladesh. The file also does not distinguish among specific internal or international destinations. It may be helpful to note that Dhaka, the capital city, was the destination of 69% of rural-urban migrants. Among international migrants, 65% moved to nations in the Middle East, primarily Saudi Arabia. Since most overseas migrants arrange their trips through manpower agencies and not through foreign consulates, there are reasons to think that migration to any foreign country confers advantages in moving to any other foreign country.

The exploratory nature of this analysis necessitated a number of decisions aimed at simplifying the definition of migrant stock. First, the file does not distinguish between moves in or out of the region, or between current and returned migrants.[8] Second, the migrant stock file accounts for whether an individual ever migrated to an urban or overseas destination, not for the total number of episodes to each destination type.[9] Each individual can contribute to migrant stock as both a rural-urban and international migrant.[10] Migrants can also contribute to the migrant stock of more than one household or village. For example, if a migrant moves to Dhaka from Household Linage A, returns, moves to Household Lineage B, and moves on to Dhaka, he would contribute to the migrant stock for each household lineage. A migrant cannot, however,

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[8] Theoretical expectations can be used to hypothesize both that return migrants should encourage migrants more than current ones, because they have more social contact with prospective migrants, or less, because they are not in a position to provide assistance. While these effects probably do not exactly cancel one another, they represent a topic for further study. In either case, migration-out should be sufficient to identify important effect

[9] This seems the most straightforward choice given that this is an analysis of networks of people, not of moves. There is no reason *a priori* to think that frequent moves increase the likelihood of chain migration.

[10] It is quite rare for an individual to have migrated to both destination types. Among men age 15-49 at the time of the 1982 census, 24% would migrate to an urban area, 11% abroad, but only 2% to both.

contribute twice to the migrant stock of the same primary network. So, if a migrant moves twice from separate households in the same household lineage, he would only be counted once. Similarly, if household A and household B are in separate household lineages but in the same *bari,* the migrant would be counted once for each primary network, but only once for the *bari*.

Step 6: Construction of Migrant History/Stock Measures

Finally, migrant stock measures are created for each of the eight reference groups (i) discussed in Steps 1-3: survey household, village, household lineage, *bari*, household lineage first- and second-order peer networks, and *bari* first- and second-order peer network. For each reference group i and destination type j (urban or overseas), the migrant stock ratio ($m_{i,j}$) is calculated simply as the ratio of migrants ($M_{i,j}$) divided by the total males age 15-49 present in the reference group in the 1993 census ($T_{i,j}$)

$$m_{i,j} = \frac{M_{i,j}}{T_{i,j}}.$$

For the substantial proportion of reference groups having no males at all (see Table 2 above), the migrant stock ratio is set to the global mean migrant stock ratio for the entire study area.

Because the migration file does not distinguish between current and returned migrants, it is not possible to identify a denominator for a standard migration prevalence rate. As such, the migrant stock ratio, henceforth referred to as “migrant stock”, simply captures the ratio of migrant males to males currently in the area.[11] From a market standpoint, the migrant stock ratio

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[11] This use of non-standard denominator is common to ethnosurvey approaches to estimating migrant stock as well. There are two possible methods for constructing standard denominators and prevalence measures using HDSS data that could be applied in future studies. If current and former migrants are distinguished, then denominators can be calculated directly as the sum of current migrants and current residents. Otherwise, the current population for each

is the most appropriate measure of migrant stock, however, since it reflects the relationship between the total number of sources of migrant-specific social capital and the total number of people who, as rural-resident males age 15-49, are potential migrants.

Table 3 summarizes migrant stock measures for each reference group. Because smaller networks are more likely to have no migrants, the mean migrant stock ratio tends to increase for higher-order networks. Medians are in all cases lower than means, indicating skewing to the right. For the primary household network, less than 50% of respondents had any migrant stock. Because the current survey household consists only of those not currently migrating, the migrant stock estimate is substantially lower than for other reference groups. In general, the migrant stock ratio for each reference group is about 0.25 for rural-urban migration (meaning that in a particular reference group there exists 1 man who ever migrated for every 4 men currently living in the study area) and 0.08 for international migration (1 ever-migrant for every 12 men in the study area).

[INSERT TABLE 3 ABOUT HERE]

Table 4 addresses interrelationships among network migrant stock measures by comparing zero-order correlations separately for rural-urban and international migrant stock. In general, the measures appear to be unique. Correlations among *bari* networks tend to be higher than for household networks because they are larger and more homogenous. At each level of linkage (primary, 1st order, 2nd order), *bari* and original household migrant stocks tend to be strongly correlated (for primary networks, the rural-urban migrant stocks are correlated at a 0.40 coefficient, while international stocks are 0.29). This is unsurprising given that household networks are principally a subset of *bari* networks. In this respect, it is useful to interpret

network can be identified from a combination of the 1982 census and subsequent death records under the assumption that men did not move from one network to another.

coefficients for household network effects as their effect over and above the coefficients for *bari*-level networks. Finally, because correlations between 1st- and 2nd-order *bari* networks are so high (0.50 for international, 0.28 for rural-urban), 2nd order *bari* network measures are not employed in the analysis.

[INSERT TABLE 4 ABOUT HERE]

Table 5 describes the interrelationships of network migrant stocks to contextual migrant stock measures and to two key endowments that predict migration, household assets and the respondent's own schooling. In the first two columns, correlations with survey household and village migrant stocks suggest that network migrant stock measures have strong external validity, with all correlations running in a positive direction. At the same time, network migrant stock measures provide unique information. Only 2nd order *bari* migrant stock is substantially similar to the village level migrant stock (0.37 for rural-urban migration, 0.43 for international), providing further justification for removing 2nd order *bari* networks from the analysis. Unsurprisingly, *bari* migrant stocks are more strongly correlated to village migrant stocks, while household lineage migrant stocks are more strongly correlated to survey household stocks. look more similar to village migrant stocks than household.

[INSERT TABLE 5 ABOUT HERE]

The final two columns of Table 5, which correlate network migrant stocks to two SES measures, offer further evidence of the external validity of network migrant stocks. As suggested by the diffusion and migration framework, migrant stock measures are for the most part positively correlated with household assets and particularly schooling. In other words, give that past migrants tend to have higher SES and households tend to stratify socially according to SES, it is unsurprising that those with high migrant stock also have high SES. The strength of this relationship begins to break for higher order linkages and for *bari* networks versus household networks, but the positive correlation to SES remains even for fairly distant connections.

These relationships offer further predictions for the statistical models. To some extent, the effects of household assets and individual schooling on the hazard of migration should be spurious. As migrant stock measures are added to a set of controls, the effects of assets and schooling on migration should become more negative. Positive effects should be attenuated and perhaps explained away, while negative effects should grow more negative.

Step 7: Matching study population to HDSS migration followup, 1997-2002

The final data management step needed to conducting an event history of analysis of migration events involves linking the adult males in MHSS households to subsequent HDSS vital event files. The privacy-protected version of MHSS identifies individuals according to their HDSS Registration IDs (RIDs). MHSS was linked to HDSS files for the period from 1996 to 2002 as part of an NIA-funded study of social networks and mortality. The sample began with the 5,831 adult males age 15 to 49 included in MHSS household rosters. Errors in the transcription of RIDs in MHSS led to the exclusion of 227 men, 0r 3.9% of the study sample, who could not be matched to the HDSS. This left 5,604 men. Complete household asset and schooling data were not available for 254 men, or 4.5% of the remaining males.

This final study sample of males age 15-49 numbered 5,350. Of these individuals, 138, or 2.6%, died before the end of the followup period in December 2002; 946 individuals, or 17.7% of the sample, made a rural-urban move; and 534, or 10.0%, moved abroad. Figure 1 graphs the Kaplan-Meier cumulative failure distributions for rural-urban and international migration, with adjustments for censoring due to rural-rural migration and death, and competing risks due to migration to the other destination type. As suggested by the migrant stock ratios, rural-urban migration is considerably more likely than international migration but both are quite common in comparison to most other settings.

[INSERT FIGURE 1 ABOUT HERE]

VI. Statistical Methods and Results

The likelihood of rural-urban and international migration is tested using Cox Proportional Hazard Models of survival. Separate models for each destination type *j* predict the relative change in the hazard (*h*) of migration by individual *x* at time *t* as the product of a baseline hazard $h_{i,0}(t)$ and a matrix of regressors measuring migrant stock ratios for the reference groups (*i*) described above ($m_{i,j,x}$) and individual and household control variables (c_x)

$$\mathrm{h}_{\mathrm{j,x}}(t) = h_{i,0}(t)\exp(\sum \beta_{i,j} m_{i,j,x} + \sum \beta c_x)$$

Models were adjusted for censoring due to death or rural-rural migration. Models of rural-urban (international) migration were adjusted to account for the competing risks of international (rural-urban) migration. Time to migration or censoring was estimated as the difference in years between the date of first migration or death event and the date that the respondent's MHSS household roster was completed. HDSS provides a high level of specificity because the exact date of migration or death was gathered from origin household members on a monthly basis.

Because all migrant stock measures for each reference group were highly skewed, models explored both the raw stocks, logged stocks, and square and cubic terms. Only the best-fitting models are presented. Is it ok to go back and forth between tenses like in the first and second sentence? Except where noted, raw and logged stocks had similar levels of association with subsequent migration. Models do not account for migrant stock to the alternate destination type.

In other words, models of rural-urban (international migration) do not account for past experience of international (rural-urban) migration.

Models include controls for individual and household demographic and socioeconomic characteristics at baseline. For the individual, these include age (expressed in five-year age categories), marital status (married vs. not married), completed schooling (divided into five groups = 0, 2-4, 5-9, 10-11, 12+); and prior years of migration experience. The models allow all age effects to vary over time. Models also control for household income and assets at baseline. The addition of migrant stock measures should improve estimates of socio-demographic controls. For instance, since younger people have little experience as migrants, estimating migrant stock should lower the age coefficient. Since wealthier households and better-educated individuals tend to have stronger social networks, migrant stock controls should lower asset and education coefficients.

Extensive robustness testing was conducted for each statistical model; this includes tests of the proportional hazards assumption by testing the trend of Schoenfield residuals for each model specification. This assumption was satisfied in most cases, but not all. Some specifications suggested that the proportionality assumption was violated for some but not all categories of the educational measure. Time-varying covariates for education are not included in order to ensure that the education coefficients are transparent for the reader to interpret. All specifications were estimated with and without time-varying education covariates, and all key findings with respect to the effects of migrant stock were robust to such changes. Each specification was also replicated using discrete-time logistic hazard regression models with time-varying interaction terms for age and education. The effects of all migrant stock measures were again robust to this change. The proportional hazard models were selected for their interpretability and, also, to take advantage of the high level of specificity in measuring the timing of migration events. Using the method identified by May and Homser (1998), goodness-of-fit tests compared the observed and expected number of migration events for the total sample and for each decile of risk.

Presentation of results will address models of rural-urban and international migration separately. With the addition of each primary and peer network migrant stock measures, I will revisit the strength of the village-level contextual migrant stock effect and summarize these changes at the end. Fixed-effects models will also be employed to better isolate network effects. Finally, I will separate peer network migrant stock effects into migrant stock for peers living in the same village and in different villages.

Models of Rural-Urban Migration

Table 5 presents a series of proportional hazard models predicting the hazard of rural-urban migration for the study population in terms of rural-urban migrant stock measures. The base model 1 includes the socio-demographic control variables and migrant stock measured at the village level. According to the May-Homser goodness-of-fit test, this model predicted 98% of observed events. Model predictions, however, predicted significantly fewer events than were actually observed for respondents in the seventh decile of risk, and significantly more events for the eighth decile.

Covariates for village-level migrant stock and the socio-demographic control variables corresponded to those observed in most other settings. The hazard of rural-urban migration was higher among those who were younger and unmarried, those from households with fewer assets, and those with greater schooling.[12] The respondent's own migration experience had a positive

[12] Effects for age were estimated in five-year ago categories, including both main effects and time-varying effects. In the interest of simplicity, age effects are not shown in Tables 6 and 8 (for international migration) in the text.

association with the hazard of further migration. Current household income was not found to have a significant effect, and was dropped from all models.

[INSERT TABLE 6 ABOUT HERE]

Village-level migrant stock was found to be a highly significant predictor of migration; a one standard deviation increase (by 0.11) was associated with a 15% increase in the hazard of migration. It is important to note, however, that the distribution of village-level migrant stock is highly skewed to the right. The much smaller difference in village-level migrant stock between the 50th and 75th percentile is only 0.06, which would result in an 8% increase in the hazard of migration. Migrant stock in the survey household, however, was not found to be significantly associated with the hazard of migration, and therefore was not included in the model.

The village migrant stock effect estimated in Model 1 establishes a baseline for comparing to each of the following models, which incrementally introduce primary and peer network effects. Model 2 introduces a covariate for the migrant stock ratio among members of the household lineage, which has a positive association with the hazard of migration that is significant at the $p<0.001$ level. This results in a 13% increase in the hazard of rural-urban migration, given a shift from a migrant stock of 0, characterizing 56% of the respondents, to 0.333, the median value. The magnitude of the village-level effect was reduced slightly. Model 2 correctly identified 98% of all observed events overall, and only in the 7th decile of risk did the predicted number of events substantially differ from the observed (lower).

Model 3 introduces the primary network effect for the migrant stock of men from the same *bari*. Unadjusted, the association between *bari* migant stock and the hazard of migration was positive but not significantly different from zero (model not shown). When this highly skewed variable was logged, however, a highly significant association ($p<0.01$) was found. This effect was of a much lower magnitude than household lineage and village effects. A one standard deviation change in *bari* migrant stock (0.29) results in only a 4% increase in the hazard of migration. A shift from the 50^{th} to 75^{th} percentile values (0.19 to 0.33) would result in only a 2% change. As mentioned above, because the household lineage is almost a perfect subset of the *bari*, the diminished but still highly significant coefficient for household lineage migrant can now be interpreted as its effect over and above the *bari* effect. A man from a household lineage whose migrant stock was 0.33 higher than his *bari*'s migrant stock would have a 9% greater hazard of migration than the average household in his *bari*. The migrant stock of both patrilineal kin groups is important, but household lineage stock is substantially more important. The village-level effect was further reduced.

Model 4 and 5 introduced the effects of first- and second-order peer networks linked through the household lineage. Model 4 included migrant stock measures separately for first and second order networks; each effect was positive, but the coefficients fell below the 5% significance level. Given the limited size of the first order network, and the high proportion of respondents having no males in their household peer networks, Model 5 tested the effect of the migrant stock for the two household lineage peer networks combined. This measure had a positive association with the hazard of migration, significant at the $p<0.01$ level. A one standard deviation change in the household lineage peer network migrant stock (0.30) resulted in an 11% increase in the hazard of migration, although the change from the 25^{th} to the 50^{th} percentile (0.12) would lead only to a 4% increase. Goodness-of-fit tests for Model 5 showed no statistically significant difference between the number of predicted and observed events for any decile of risk. The village-level effect was again reduced, while primary network effects remained unchanged.

Model 6 introduced the effect of migrant stock in the first-order *bari* peer network, which again has a positive and highly significant association (p<0.001) with the hazard of migration. The effect is much smaller than for household lineage peers: a one standard deviation change (0.28) results in a 5% increase in the hazard and a shift from first to third quartile (0.06) results in a 1% increase. The *bari* level peer effect does not, however, result in a reduction in the household lineage peer effect. The village effect was once again reduced in Model 6. Between these two models, the estimated effect of any given increase in village migrant stock on the relative hazard of rural-urban migration declined by about 45%.

A comparison between Models 6 and 1 reveals substantial change in the effects of the sociodemographic control variables on the hazard of migration. A majority of these changes are accounted for by the addition of the primary and peer network effects. The negative household asset effect grows more negative since all measures of migration-specific social capital tend to have a positive correlation with assets. The highly significant and positive effects of education diminish at all levels. The relative change in hazard due to having 2-4 years of schooling (compared to zero years) declines by only 2%, with much larger declines for 5-9 years of schooling (19%); 10-11 years of schooling (14%); and 12+ years of schooling (12%).Because of the positive correlation between schooling and migrant networks, we tend to overestimate the effects of schooling on the hazard of migration. Finally, the effect of an individual's prior rural-urban migration experience on the hazard of migration declines to the level of statistical insignificance after controlling for networks effects.

Having established the importance of peer network migrant stock as a significant predictor of rural-urban migration, the next step is to understand differences in the effects of peer living inside and outside the village. Do peer network effects merely reflect differences in the strength of social ties within a village, or do they also reflect the influence of peers living outside the village? The tests shown in Table 7 offer fairly simplistic attempts to address this question by separating the peer migrant stock ratio effects into ratios for peers living inside and outside the village. In both the case of household and *bari* peers, the models show no statistically significant differences between the effect of those inside or outside the village. We therefore can neither say that peers from outside or inside the the village are more important. In other words, differences in peer networks leading to a greater hazard of rural-urban migration for some households reflect both differences in the strength of ties within and outside the community.

[INSERT TABLE 7 ABOUT HERE]

Models of International Migration

Table 8 presents proportional hazard models of international migration. Model 1 first included socio-demographic controls and contextual migrant stock effects. Goodness-of-fit tests show that the expected number of events equals 101% of the total observed events, and expected results only differ significantly from observed in the fourth decile of risk.

[INSERT TABLE 8 ABOUT HERE]

As with the rural-urban migration models, socio-demographic effects correspond to those found in previous studies. Unlike rural-urban migration, international migration is more likely among respondents from households with higher assets. This reflects the high costs and risks of international migration, and should be diminished by the inclusion of migrant stock controls. Net of the asset effect, households with higher incomes are somewhat less likely to move abroad. Overall, schooling has a positive association with international migration. Schooling effects, however, are much smaller than for rural-urban migration, and only respondents with 5-9 or 10-

11 years of schooling differ significantly from those with no education.[13] As with the models for rural-urban migration, an individual's own years of prior migration experience significantly increase the likelihood of subsequent international migration.

Village-level international migrant stocks had a highly significant and positive association with the hazard of international migration when a main effect, square, and cubic term were all incorporated (main effect and square model not shown). This effect was quite complex, but was unaffected by the inclusion of network effects (see below) or the estimation of discrete-time models. Because of the complexity of the village-level effect, its specific impact on relative risks will be described at the conclusion of the analysis.

Model 2 adds in the effects of primary household lineage migrant stock, which are positive and significantly differ from zero at the $p<0.001$ level. This relationship is the strongest and most statistically significant result in the study. A one standard deviation change (0.18) is associated with a 20% increase in the hazard of international migration, but it is important to remember that 82% of respondents were from household lineages with no international migrant stock. This effect results in a substantial reduction in the village migrant stock effect.

Model 3 adds the *bari* primary network effect. When entered with a log transformation, the *bari* effect was significant at the $p<0.05$ level. A one standard deviation change (0.17) was associated with a 2% increase in the migration hazard. After controlling for the *bari* effect, the household lineage effect was diminished, with one standard deviation change resulting in a 16% increase in migration risk. Given the high correlation between *bari* and village migrant stocks, it is unsurprising that the village migrant stock effect is substantially reduced.

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[13] Lindstrom and Massey (2001) and Kuhn (2005) both attribute the more limited role of schooling in the international migration process to the limited returns to schooling in unskilled professions that temporary international migration often occupy.

Models 4, 5, and 6 introduce household lineage and *bari* peer network effects. While first order household peers are not statistically associated with the hazard of migration, second order household peer effects are moderately significant (at the $p<0.05$ level), with a one standard deviation increase associated with an 11% increase in the hazard of migration. First-order *bari* peer effects do not have a statistical association with migration hazard.

After controlling for all network effects, Model 5, the best-fitting model, had a diminishing effect on the socio-demographic effects found in Model 1. The household asset effect was reduced by about 15%. The effect of the respondent's previous years of international migration experience was reduced by 29%. Education effects also declined slightly.

VII. Conclusion

The preceding analysis demonstrates the empirical and interpretive value of considering migration-specific social capital not merely as a contextual characteristic of communities, but as a resource that is dispersed heterogeneously among members of a community. As shown in Figure 2, controlling for migrant stocks among primary and peer networks explains away about half of the effect of village-level migrant stock on the hazard of migration. It is therefore important to temper any expectations that migration opportunities will diffuse through an entire community. In the case of international migration, the model with network effects suggests that the parabolic relationship between village migrant stock and relative migration hazard is not only smaller than expected, but also peaks and becomes negative at a much lower level of migrant stock.

[INSERT FIGURE 2 ABOUT HERE]

Instead, the migrant stock held by members of a respondent's primary and peer networks explains a more substantial share of the variation in migration hazard. Furthermore, peers from outside the village have as much explanatory power as those inside the village. A strictly contextual model could not capture these effects, overlooking the critical importance of extra-community ties in allowing migration opportunities to jump from community to community.

The results also highlight a tendency for contextual models of migration to produce spuriously positive estimates for the sociodemographic correlates of migration. In all cases, Table 5 found a positive correlation between lineage and peer network migrant stock and measures of physical and human capital. Village migrant stocks, on the other hand, are largely uncorrelated with endowments. As a result, models without network effects overstated the positive effects of schooling, overstated the positive effects of assets on international migration, and understated the negative association between assets and rural-urban migration.

It is important to be critical when integrating existing models of migration at the individual, household, and community levels (Arango 2000). The typical individual and household factors entered into migration models (education, wealth, income, age) tend to specify a relationship between stratification and migration. Yet community-based measures of migrant stock inherently restrict the array of possible results to those that imply declining within-community inequality. While the contextual approach may effectively differentiate between communities with better or worse overall endowments, it cannot address persistent within-community heterogeneity in individual and household access to community endowments such as migration-specific social capital. The multidimensional process of chain migration reflects both contextual and contingent opportunities.

Three major questions remain in addressing the extent to which the chain migration process is contextual or conditional. First, are contextual and conditional forms of migration-specific social capital complements or substitutes? In other words, is it sufficient to have either peer-based or community-based access to migration, or is it necessary to have both? A test of the interactions between contextual and network migrant stock measures can answer this question.

Second, are the various forms of migration-specific social capital complements or substitutes to individual and household endowments such as education and assets? If they are substitutes, then migration-specific social capital could narrow socioeconomic disparities in access to migration. If they are complementary, however, we would identify another source of exclusion in the chain migration process. Even households that have high strong peer networks may only be able to utilize them through the direct or indirect expenditure of resources as a “buy-in” to the network (Portes and Sensenbrenner 1993; Portes 1998; Stark and Wong 2002). This concern can be addressed by testing interactions between migrant stock and endowments.

Finally, it remains important to understand variations in the quality of migration opportunities, and how the quality of migration opportunities might diminish as the chain migration process unfolds. Do households that move first and bear substantial risk benefit more from migration than those who move later, expending little human or social capital?

This study has begun to address the functional mechanisms underlying chain migration, and has set the stage for understanding the implications of chain migration for household migration opportunities. Although the migration process can affect non-migrant households in a community through a variety of indirect pathways, our understanding of the relationship between migration and within-community opportunity and inequality ultimately depends on the pathways of transmission of migration opportunities themselves (Taylor 1992; Taylor and Wyatt 1996). Until we better understand how chain migration, migrant networks, and migration-specific social capital operate, it would be safer to assume that their effects on inequality are neutral, not positive.

References

Aguilera, Michael B. 2003. "The Impact of the Worker: How Social Capital and Human Capital Influence the Job Tenure of Mexican Immigrants." *Sociological Inquiry* 73(1):52-83.

Aguilera, Michael B., and Douglas S. Massey. 2003. “Social Capital and the Wages of Mexican Migrants: New Hypotheses and Tests.” *Social Forces* 82(2): 671-701.

Arango, Joaquin. 2000. “Explaining Migration: A Critical View.” *International Social Science Journal* 52(3): 283-296.

Burt, Ronald S. 1998. “The Gender of Social Capital.” *Rationality and Society* 10(1): 5-46.

Burt, Ronald S. 2000. “The Network Structure of Social Capital.” *Research in Organizational Beahvior* 22: 345-423.

Carrington, William J., Enrica Detragiache, and Tara Vishwanath. 1996. “Migration with Endogenous Moving Costs.” *American Economic Review* 86(4): 909-930.

Collyer, Michael. 2005. “When do Social Networks Fail to Explain Migration? Accounting for the Movement of Algerian Asylum-Seekers to the UK.” *Journal of Ethnic and Migration Studies* 31(4): 699-718.

Curran, Sara R., and Estela Rivero-Fuentes. 2003. “Engendering Migrant Networks: The Case of Mexican Migration.” *Demography* 40(2): 289-307.

Das, Raju J. 2004. “Social Capital and Poverty of the Wage-Labour Class: Problems with the Social Capital Theory.” *Transactions of the Institute of British Geographers* 29(1): 27-45.

Davis, Benjamin, and Paul Winters. 2001. “Gender, Networks and Mexico-US Migration.” *Journal of Development Studies* 38(2): 1-26.

Davis, Benjamin, Guy Stecklov, and Paul Winters. 2002. “Domestic and International Migration from Rural Mexico: Disaggregating the Effects of Network Structure and Composition.” *Population Studies* 56(3): 291-309.

Durand, Jorge, Douglas S. Massey, Rene M. Zenteno. 2001. “Mexican Immigration to the United States: Continuities and Changes.” *Latin American Research Review* 36(1): 107-127.

Ebaugh, Helen Rose and Mary Curry. 2000. “Fictive Kin as Social Capital in New Immigrant Communities.” *Sociological Perspectives* 43(2): 189-209.

Elmhirst, Rebecca. 2002. “Daughters and Displacement: Migration Dynamics in an Indonesian Transmigration Area.” *Journal of Development Studies* 38(5): 143-166.

Espinosa, Kristin E., and Douglas S. Massey 1997. "Undocumented Migration and the Quantity and Quality of Social Capital." *Soziale Welt* 12:141-62.

Foster, Andrew D. 2005. “Altruism, Household Coresidence and Women’s Health Investment in Rural Bangladesh.” Unpublished Manuscript, Brown University

Greenwell, Lisa, R. Burciaga Valdez, and Julie DaVanzo. 1997. “Social Ties, Wages, and Gender in a Study of Salvadorean and Filipino Immigrants in Los Angeles.” *Social Science Quarterly* 78(2): 559-577.

Hagan, Jacqueline. and Helen Rose Ebaugh. 2003. “Calling upon the Sacred: Migrants' Use of Religion in the Migration Process.” *International Migration Review* 37(4): 1145-1162.

Joshi Shareen and Nistha Sinha. 2005. “The Effect of Household Partition on Children’s Work and Schooling in Rural Bangladesh.” Unpublished Manuscript, Yale University.

Kandel, William, and Douglas S. Massey. 2002. “The Culture of Mexican Migration: A Theoretical and Empirical Analysis.” *Social Forces* 80(3): 981-1004.

Krishna, Anirudh. 2004. “Understanding, Measuring and Utilizing Social Capital: Clarifying Concepts and Presenting a Field Application from India.” *Agricultural Systems* 82(3): 291-305.

Krissman, Fred 2005. “Sin Coyote Ni Patron: Why the ‘Migrant Network’ Fails to Explain International Migration.” *International Migration Review* 39(1): 4-44.

Kuhn, Randall. 2003. “Identities in Motion: Social Exchange Networks and Rural-Urban Migration in Bangladesh.” *Contributions to Indian Sociology* 37: 311-337.

Kuhn, Randall. 2005. “The Effects of Fathers’ and Siblings’ Migration on Children’s Pace of Schooling in a Migrant-Sending Region of Bangladesh.” Workshop on The Impacts of Migration on the "Left-Behind" in Asia, Asian MetaCentre, National University of Singapore, Hanoi, Vietnam, March 2005.

Lindstrom, David P., and Douglas S. Massey. 1994. “Selective Emigration, Cohort Quality, and Models of Immigrant Assimilation.” *Social Science Research* 23:315-349.

Lindstrom, David P., and Nathanael Lauster. 2001. “Local Economic Opportunity and the Competing Risks of Internal and US Migration in Zacatecas, Mexico.” *International Migration Review* (354): 1232-1256.

Massey, Douglas S. 1990. “Social Structure, Household Strategies, and the Cumulative Causation of Migration.” *Population Index* 56:3-26.

Massey, Douglas S., Luin P. Goldring, and Jorge Durand. 1994. "Continuities in Transnational Migration: An Analysis of 19 Mexican Communities." *American Journal of Sociology* 99:1492533.

Massey, Douglas S., Rafael Alarcón, Jorge Durand, and Humberto González. 1987. *Return to Aztlan: The Social Process of International Migration from Western Mexico*. London, England: University of California Press.

Massey, Douglas S., Joaquín Arango, Graeme Hugo, Ali Kouaouci, Adela Pellegrino, and J. Edward Taylor. 1999. *Worlds in Motion: Understanding International Migration at The End of The Millennium*. New York: Oxford University Press.

May, S., and D.W. Hosmer. 1998. "A Simplified Method of Calculating an Overall Goodness-of-Fit Test for the Cox Proportional Hazards Model." *Lifetime Data Analysis*, 4: 109-120.

Menjivar, Cecilia. 2002. "The Ties That Heal: Guatemalan Immigrant Women's Networks and Medical Treatment." *International Migration Review* 36(2): 437-466.

Munshi, Kaivan. 2003. "Networks in the Modern Economy: Mexican Migrants in the US Labor Market." *Quarterly Journal of Economics* 118(2): 549-599.

Palloni, Alberto, Douglas S. Massey, Miguel Ceballos, Kristin Espinosa, and Michael Spittel. 2001. "Social Capital and International Migration: A Test Using Information on Family Networks." *American Journal of Sociology* 106(5): 1262-1298.

Portes, Alejandro. 1998. "Social Capital: Its Origins and Applications in Modern Sociology." *Annual Review of Sociology* 24:1-24.

Portes, Alejandro. 2000. "The Two Meanings of Social Capital." *Sociological Forum* 15(1):1-12.

Portes, Alejandro and Robert L. Bach. 1985. *Latin Journey: Cuban and Mexican Immigrants in The United States*. Berkeley: University of California Press.

Rosenzweig, Mark R., and Oded Stark. 1989. "Consumption Smoothing, Migration, and Marriage." *Journal of Political Economy* 97: 905-926

Sanders, Jimy, Victor Nee, Scott Sernau. 2002. "Asian Immigrants' Reliance on Social Ties in a Multiethnic Labor Market." *Social Forces* 81(1): 281-314.

Shah, Nasra M. 2000. "Relative Success of Male Workers in the Host Country, Kuwait: Does the Channel of Migration Matter?" *International Migration Review* 34(1): 59-78.

Shah, Nasra M., and Indu Menon. 1999. Chain Migration through the Social Network: Experience of Labour Migrants in Kuwait." *International Migration* 37(2): 361-382.

Silvey, Rachel, and Rebecca Elmhirst. 2003. "Engendering Social Capital: Women Workers and Rural-Urban Networks in Indonesia's Crisis." *World Development* 31(5): 865-879.

Stark, Oded, and You Qiang Wang. 2002. "Migration dynamics." *Economics Letters* 76(2): 159-164.

Strang, David, and Sarah A. Soule. 1998. "Diffusion in Organizations and Social Movements: From Hybrid Corn to Poison Pills." *Annual Review of Sociology* 24: 265-290.

Taylor, J. Edward. 1986. "Differential Migration, Networks, Information, and Risk." Pp. 147-171 in *Research in Human Capital and Development: Migration, Human Capital, and Development*, Volume 4, edited by Oded Stark. Greenwich, CT: JAI Press, Inc.

Taylor, J. Edward. 1992. "Remittances and Inequality Reconsidered: Direct, Indirect, and Intertemporal Effects." *Journal of Policy Modeling* 14:187-208.

Taylor, J. Edward and T. J. Wyatt. 1996. "The Shadow Value of Migrant Remittances, Income and Inequality in a Household-farm Economy." *The Journal of Development Studies* 32(6):899-912.

Van der Gaag, Nicole, and Leo Van Wissen. 2002. "Modelling Regional Immigration: Using Stocks to Predict Flows." *European Journal of Population* 18(4): 387-409.

Waldorf, Brigitte. 1996. "The Internal Dynamic of International Migration Systems." *Environment and Planning A* 28(4): 631-650.

Wegge, Simon A. 1998. "Chain Migration and Information Networks: Evidence from Nineteenth-Century Hesse-Cassel." *Journal of Economic History* 58(4): 957-986.

Wejnert, Barbara. 2002. "Integrating Models of Diffusion of Innovations: A Conceptual Framework." *Annual Review of Sociology* 28: 297-326.

Wilson, Tamar Diana. 1998. "Weak Ties, Strong Ties: Network Principles in Mexican Migration." *Human Organization* 57(4): 394-403.

Winters, Paul, Benjamin Davis, and Leonardo Corral. 2002. "Assets, Activities and Income Generation in Rural Mexico: Factoring in Social and Public Capital." *Agricultural Economics* 27(2): 139-156.

Winters, Paul, Alain de Janvry, and Elizabeth Sadoulet. 2001. "Family and Community Networks in Mexico-US Nigration." *Journal of Human Resources* 36(1): 159-184.

Zhao, Yaohui. 2003. "The Role of Mmigrant Networks in Labor Migration: The Case of China." *Contemporary Economic Policy* 21(4): 500-511.

Table 1: Migrant Network Levels of Aggregation Summarized

Traditional Primary Networks		
Survey Household		
Village		
New Primary Networks	**New Peer Networks**	
Household lineage	1st order household peers	2nd order household peers
Bari (compound) lineage	1st order *bari* peers	2nd order *bari* peers

Table 2: Summary of Reference Group Composition

Reference Group	Links			Males		
	Mean	S.D.	Max	Mean	S.D.	Max
Contextual units						
MHSS household				2.4	1.2	8
Village				1351.8	1067.4	4181
Household lineage networks						
Primary network				5.3	6.1	66
First-order peers	1.7	1.7	13	7.4	11.5	123
Second-order peers	3.2	4.5	43	13.4	23.3	302
Bari networks						
Primary network				29.2	22.6	226
First-order peers	11.8	9.6	55	335.1	312.6	1900
Second-order peers	152.4	141.3	850	4384.9	4366.5	23304

Source: HDSS (1974-1996)

Table 3: Summary of Migrant Stock for each Reference Group

Reference Group	Urban Migration			International Migration		
	Mean	SD	Median	Mean	SD	Median
Contextual units						
MHSS household	0.074	0.147	0.000	0.018	0.075	0.000
Village	0.252	0.107	0.241	0.084	0.061	0.066
Household lineage networks						
Primary network	0.219	0.421	0.000	0.058	0.185	0.000
First-order peers	0.279	0.399	0.245	0.093	0.199	0.083
Second-order peers	0.286	0.439	0.245	0.086	0.153	0.083
Bari						
Primary network	0.255	0.291	0.188	0.084	0.173	0.042
1st order peers	0.257	0.277	0.237	0.079	0.097	0.063
2nd order peers	0.237	0.075	0.243	0.077	0.058	0.065

Source: HDSS (1974-1996)

Table 4: Zero Order Correlations Among Network Migrant Stock Ratios

Panel A: Rural-Urban Migration

	Household Lineage			Bari Lineage		
	Primary Networks	Peer Networks		Primary Networks	Peer Networks	
		1st order	2nd order		1st order	2nd order
Household Lineage						
Primary	1.00					
1st Order Peer	0.05	1.00				
2nd Order Peer	0.01	0.07	1.00			
Bari Lineage						
Primary	0.40	0.10	0.03	1.00		
1st Order Peer	0.05	0.14	0.01	0.08	1.00	
2nd Order Peer	0.12	0.12	0.09	0.17	0.28	1.00

Panel B: International Migration

	Household Lineage			Bari Lineage		
	Primary Networks	Peer Networks		Primary Networks	Peer Networks	
		1st order	2nd order		1st order	2nd order
Household Lineage						
Primary	1.00					
1st Order Peer	0.06	1.00				
2nd Order Peer	0.01	0.09	1.00			
Bari Lineage						
Primary	0.29	0.05	0.04	1.00		
1st Order Peer	0.05	0.15	0.11	0.22	1.00	
2nd Order Peer	0.03	0.10	0.13	0.31	0.50	1.00

Source: HDSS (1974-1996)

Table 5: Zero Order Correlation of Peer Network Migrant Stock Ratios to Conventional Migrant Stock Ratios and SES Measures

	Rural-Urban Migration			
	Migrant Stock Ratio		SES	
Household Lineage	Survey HH	Village	HH Assets	Schooling
Primary	0.32	0.10	0.06	0.10
1st Order Peer	0.00	0.11	0.06	0.09
2nd Order Peer	0.00	0.04	0.05	0.06
Bari Lineage	Survey HH	Village	HH Assets	Schooling
Primary	0.18	0.24	0.05	0.09
1st Order Peer	0.04	0.19	0.05	0.07
2nd Order Peer	0.09	0.37	0.14	0.13

	International Migration			
	Migrant Stock Ratio		SES	
Household Lineage	Survey HH	Village	HH Assets	Schooling
Primary	0.37	0.07	0.12	0.13
1st Order Peer	0.05	0.07	0.11	0.10
2nd Order Peer	-0.00	0.14	0.08	0.05
Bari Lineage	Survey HH	Village	HH Assets	Schooling
Primary	0.12	0.34	0.04	0.05
1st Order Peer	0.01	0.33	0.01	0.04
2nd Order Peer	-0.00	0.43	-0.00	0.01

Source: MHSS (1996) and HDSS (1974-1996)

Table 6: Covariates from Cox Proportional Hazard Model of Rural-Urban Migration

Demographic / Socioeconomic Controls	(1)	(2)	(3)	(4)	(5)	(6)
Respondent Married	-0.404*	-0.395*	-0.372*	-0.368*	-0.364*	-0.362*
	(0.176)	(0.176)	(0.176)	(0.176)	(0.177)	(0.176)
Household assets (logged)	-0.104**	-0.109**	-0.111**	-0.116**	-0.118**	-0.120**
	(0.036)	(0.037)	(0.037)	(0.037)	(0.036)	(0.036)
Schooling (0 years = reference)						
2-4 years	0.514**	0.510**	0.501**	0.501**	0.504**	0.502**
	(0.167)	(0.165)	(0.164)	(0.165)	(0.164)	(0.165)
5-9 years	0.421**	0.397**	0.368*	0.360*	0.357*	0.353*
	(0.153)	(0.153)	(0.155)	(0.153)	(0.154)	(0.154)
10-11 years	0.858**	0.824**	0.799**	0.792**	0.782**	0.774**
	(0.172)	(0.172)	(0.176)	(0.176)	(0.176)	(0.177)
12+ years	1.071**	1.027**	0.998**	0.992**	0.996**	0.992**
	(0.239)	(0.235)	(0.234)	(0.233)	(0.235)	(0.236)
Total Years Living in City	0.068**	0.052*	0.048	0.048	0.047	0.047
	(0.023)	(0.026)	(0.026)	(0.025)	(0.025)	(0.025)
Migrant Stock Ratios	(1)	(2)	(3)	(4)	(5)	(6)
Village level	1.252**	1.189**	1.004**	0.963**	0.939**	0.868**
	(0.288)	(0.292)	(0.298)	(0.298)	(0.300)	(0.304)
Primary network level						
Household lineage		0.373**	0.258**	0.258**	0.254**	0.252**
		(0.081)	(0.096)	(0.095)	(0.096)	(0.096)
B*ari* (logged)			0.126**	0.121**	0.121**	0.120**
			(0.041)	(0.041)	(0.041)	(0.041)
Peer network level						
Household 1st order				0.165		
				(0.090)		
Household 2nd order				0.079		
				(0.060)		
Household 1st/2nd order					0.353**	0.343**
					(0.131)	(0.132)
Bari 1st order						0.182**
						(0.055)
Sample Diagnostics	(1)	(2)	(3)	(4)	(5)	(6)
F-Test Statistic:	474.65	487.54	500.7	514.13	534	634.52
Degress of Freedom	20	21	22	24	23	24
????	0.03	0.04	0.04	0.04	0.04	0.06

Source: MHSS (1996) and HDSS(1974-2002)
Sample size for all models = 5,350
Robust standard errors in parentheses; * significant at 5%; ** significant at 1%

Table 7: Separating Peer Network Effects on Rural-Urban Migration into Same Village and Different Village

Household 1st & 2nd order peers	(1)	(2)	(3)	(4)
Combined	0.343**		0.342**	
	(0.132)		(0.132)	
Same Village		0.230**		0.229**
		(0.085)		(0.086)
Different Village		0.093		0.088
		(0.115)		(0.115)
Chi-Square Difference Test		0.85		0.89
Bari 1st order peers	(1)	(2)	(3)	(4)
Combined	0.182**	0.196**		
	(0.055)	(0.051)		
Same Village			0.056	0.039
			(0.109)	(0.116)
Different Village			0.169**	0.186***
			(0.056)	(0.049)
Chi-Square Difference Test			0.77	1.25

Source: MHSS (1996) and HDSS(1974-2002)
Sample size for all models = 5,350
Robust standard errors in parentheses; * significant at 5%; ** significant at 1%

Table 8: Covariates from Cox Proportional Hazard Model of International Migration

Demographic/Socioeconomic Controls	(1)	(2)	(3)	(4)	(5)	(6)
Household assets (logged)	0.227**	0.208**	0.197**	0.193**	0.190**	0.190**
	(0.054)	(0.053)	(0.053)	(0.053)	(0.054)	(0.053)
Household income (logged)	-0.034*	-0.031*	-0.030	-0.030	-0.029	-0.030
	(0.015)	(0.015)	(0.016)	(0.016)	(0.016)	(0.016)
2-4 years schooling	0.008	-0.002	0.001	0.002	0.001	-0.001
	(0.242)	(0.233)	(0.235)	(0.236)	(0.235)	(0.235)
5-9 years schooling	0.561**	0.539**	0.530**	0.525**	0.522**	0.529**
	(0.163)	(0.163)	(0.162)	(0.163)	(0.162)	(0.163)
Completed lower secondary	0.384*	0.313	0.298	0.309	0.301	0.306
	(0.188)	(0.188)	(0.185)	(0.185)	(0.183)	(0.182)
Completed upper secondary or higher	0.142	0.167	0.159	0.179	0.176	0.194
	(0.374)	(0.365)	(0.364)	(0.365)	(0.364)	(0.365)
Respondent's Past Migration Years	0.165**	0.124*	0.119	0.119	0.119	0.120*
	(0.057)	(0.060)	(0.061)	(0.061)	(0.061)	(0.061)
Migrant Stock Ratios	(1)	(2)	(3)	(4)	(5)	(6)
Village migrant stock ratio	18.7**	17.4**	14.9**	13.9*	13.7*	13.6**
	(6.28)	(6.11)	(6.13)	(6.12)	(6.16)	(6.2)
Village migrant stock ratio (squared)	-93.9**	-89.3**	-80.8*	-74.7*	-74.2*	-70.8*
	(33.0)	(32.1)	(31.7)	(31.7)	(31.7)	(32.8)
Village migrant stock ratio (cubed)	99.6**	95.2**	86.4*	74.1*	73.4*	68.8
	(37.1)	(36.2)	(35.7)	(35.3)	(35.4)	(36.8)
Primary Extended Networks						
Household Lineage		0.996**	0.780**	0.792**	0.793**	0.797**
		(0.149)	(0.231)	(0.227)	(0.227)	(0.230)
Bari (logged)			0.133*	0.136*	0.134*	0.138*
			(0.054)	(0.054)	(0.054)	(0.054)
Peer Networks						
Household 1st order				-0.192		
				(0.201)		
Household 2nd order				0.673**	0.652*	0.680**
				(0.251)	(0.255)	(0.246)
Bari 1st order						-0.936
						(1.220)
Sample Diagnostics	(1)	(2)	(3)	(4)	(5)	(6)
F-Test Statistic:	306.84	401.65	453.43	475.19	469.12	466.53
Degrees of Freedom	22	23	24	26	25	26

Source: MHSS (1996) and HDSS(1974-2002)
Sample size for all models = 5,288
Robust standard errors in parentheses; * significant at 5%; ** significant at 1%

Figure 1: Kaplan-Meier Estimates of Cumulative Failure Distribution for Rural-Urban and International Migration

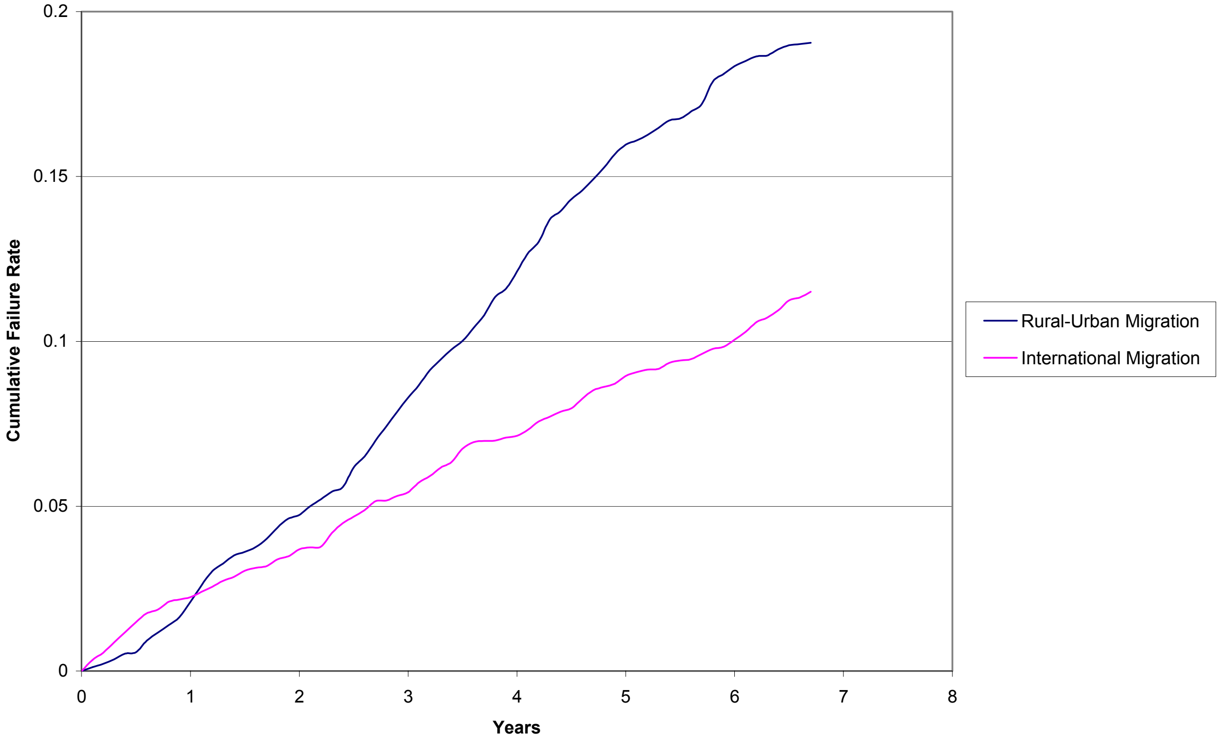
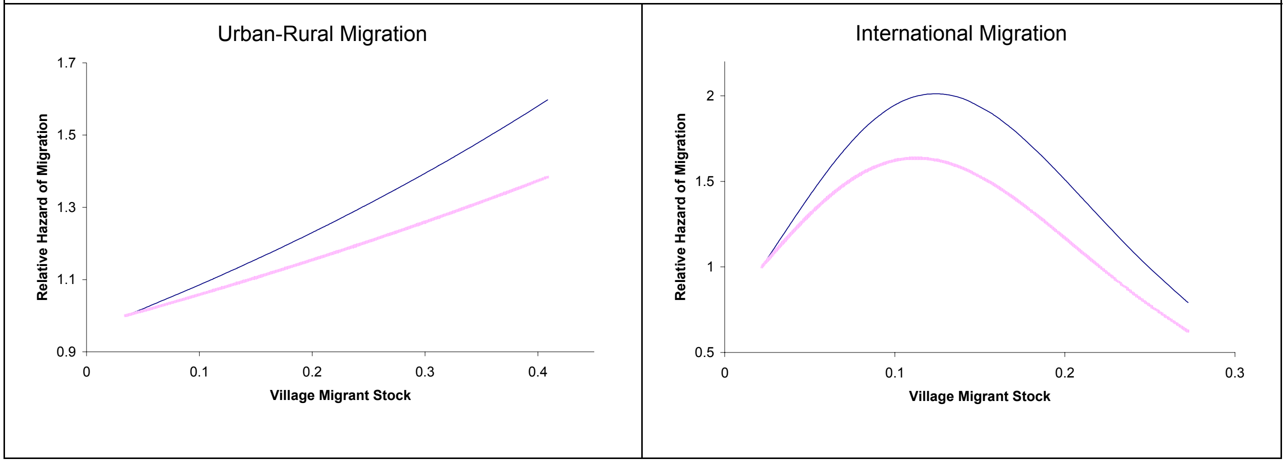


Figure 2: Estimated Impact of Village Migrant Stock on Relative Hazard of Migration With and Without Controlling for Network Effects, by Migrant Destination Type



Notes: Lower line indicates model with network effects, upper line without network effects.