

Do Peer Effects Influence Household Decision Making? Evidence from Child Food Intake in India

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This Version: April 2, 2014

Abstract

We use primary data from Uttarakhand, India to show that peer effects exist in household decision making. Using participation in a female education program, *Mahila Samakhya*, to identify changes in empowerment, we examine how friends' program participation affects (1) a woman's physical mobility, (2) access to outside employment, (3) likelihood of working outside the household, and (4) her children's food intake. We then use an extension of a spatial weighting technique that relies on friends of friends to identify peer effects on bargaining power and child food intake, adding in instruments for endogenous group formation and program participation. Results show that peer effects have a significant effect on all proxies of female bargaining power, including children's food intake. We find that *Mahila Samakhya* participants whose friends also participate are more likely to (1) leave the house without permission, (2) have access to the National Rural Employment Guarantee Scheme (NREGS), and (3) work for pay outside the household. At the same time, we find that non-participants who nonetheless have friends in *Mahila Samakhya* are *less* likely to have access to NREGS although they are more likely to work outside the household, suggesting that peers may induce occupational switching. We find an overall positive effect of the mother's friends' empowerment levels on her children's food intake. In addition, we find that girls whose mothers have more empowered friends eat a better quality diet relative to the boys in the same household. This last finding corresponds to the literature suggesting that empowered women invest more in their daughters than in sons. Finally, combining the Nash bargaining framework with the demographic diffusion literature and identity economics, we define and provide suggestive empirical evidence on three ways in which networks function: (1) information, (2) influence, and (3) identity. While this analysis refrains from making welfare conclusions, our results highlight the presence of significant and complex peer effects in household decision making.

JEL Codes: D13, D85, J13, O15

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1.1 Motivation

Peer effects have been extensively examined in the context of informational spillovers (Kohler et al., 2001; Conley and Udry, 2010; Miguel and Kremer, 2004; Foster and Rosenzweig, 1995; Oster and Thornton, 2012), but their impact on social norm-driven behaviors, whether negative or positive, is less understood, particularly outside the context of health-seeking behavior adoption (Munshi and Myaux, 2006; Christakis and Fowler, 2008; Lundborg, 2006). We also know that some outcomes appear very difficult to alter: female household bargaining power and child malnutrition in India are two classic examples that don't necessarily change with increases in income (Haddad et al., 2003) or even access to information Kabeer (1999) and health interventions (Das Gupta et al., 2005). On the other hand, increasing evidence suggests that these very outcomes change rapidly under circumstances that typically involve changing social norms or expectations (Munshi and Myaux, 2006; Jensen and Oster, 2009; Chong and La Ferrara, 2009; La Ferrara et al., 2012). Female empowerment is one area where social norms may be expected to play a large role. Since women tend to invest more in their children than do fathers (Oster, 2009; Beegle et al., 2001; Rosenzweig and Schultz, 1982; Maitra, 2004; Thomas et al., 2002; Quisumbing and de la Brière, 2000), evidence of an impact of friends' empowerment levels on a woman's children's food intake would be suggestive of a channel that works through the household bargain.

In this paper, we ask whether through social networks, peers affect female bargaining power and children's food intake. Further, we explore whether the peer effects work through information, influence or identity utility. We collect primary data on self-reported networks, female empowerment, and child nutrition in rural north India because existing datasets do not report information on peer networks. The data are from the state of Uttarakhand in the Indian Himalayas. We identify a shock to female bargaining power and social networks using a government program called *Mahila Samakhya*. The program aims to increase female empowerment through education and has been in place in Uttarakhand since 1995, but was rapidly and randomly scaled up between 2004 and 2008. Our sample consists of 487 women from 69 villages that received the program during this expansionary phase. Our survey area covers six randomly-chosen Uttarakhand districts, four with the program and two without. (The survey districts are represented in Figure 1 with a dotted pattern. The four districts with a thick border and dotted patterns are program districts. The two dotted districts without a thick border are non-program districts.)

Peer networks provide their members new information about employment opportunities (Munshi and Rosenzweig, 2006), supply marital partners (Banerjee et al., 2009), facilitate adoption of new technologies (Conley and Udry, 2010), but homophily-induced homogeneous networks may limit the network's ability to affect social norms or at least delay the process, since both information and social norms are likely already

common to the network, and may well presumably be reinforced instead of challenged by network connections. Indeed, economists have found both theoretical and empirical evidence suggesting that homophily slows social learning and therefore convergence in the adoption of new technologies (Behrman et al., 2002; Golub and Jackson, 2012, 2010).

A woman’s ability to influence household resource allocation depends not only on the information available to her but also on her notion of identity and the utility she receives from it,¹ her bargaining power, and the social norms,² as well as the interactions of these forces. Identity and norms can be a source of strength and confidence (Sen, 2006) but in the presence of constricting social norms, identity can equally confine and limit power. Indeed, social capital can work against empowerment in conservative communities (Hoff and Pandey, 2006; Mayoux, 2001). In remote and poor regions, we argue that peer networks are an effective way to counter social norms, change bargaining power and hence affect child food intake. In addition to learning new information from peers, individuals may also want to emulate friends and define their well-being relative to their peers. Friends provide thus not only provide information but also directly influence behavior, thus helping define identity. Peer networks in traditional societies may be homogenous and stratified by income or social hierarchy, therefore reinforcing social norms. Conservative social norms will reinforce current bargaining power patterns, which are often skewed to the male in the household. It is thus important to understand how peer effects, whether negative or positive, affect norm-driven household behavior.

To study whether peer networks influence bargaining power and therefore child welfare, we test the following hypotheses: (1) Does the bargaining power of a woman’s peers affect her own bargaining power? (2) Do social learning and influence cause networks to change a woman’s parenting behavior? We develop a utility maximization model where consumption smoothing gives parents an economic incentive to invest in their children. This incentive may be larger for women who face lower future income prospects. Peers affect a woman’s allocation decision in three ways: first, support groups provide support, thus increasing her disagreement utility, and allow her greater control of household resources.³ Second, learning from friends removes constraints placed by social norms, allowing the woman a greater range of choices in her domestic life. Third, identity utility from belonging to networks causes a woman to be influenced by her friends’ choices, and gain utility from mimicking their actions, which may increase or decrease a woman’s say in her household’s decision making process.

We examine how a woman’s friends’ participation in *Mahila Samakhya* affects four dimensions of house-

¹Identity utility is the “gain when actions conform to actions and ideals, and the loss insofar as they do not” (Akerlof and Kranton, 2010, p. 18).

²A social norm refers to the behavioral expectations within society or a sub-group of society. Norms “coordinate people’s expectations in interactions that possess multiple equilibria” (Durlauf and Blume, 2008).

³Disagreement or threat-point utility refers to the utility each adult receives if the household bargain fails and cooperation breaks down (Mas Colell et al., 1995, p. 839).

hold decision making: (1) the woman’s physical mobility, (2) her access to outside employment and (3) likelihood of working outside the household, as well as (4) her children’s food intake.⁴ We then use an extension of a spatial weighting technique that relies on friends of friends to identify peer effects along these four dimensions, while also instrumenting for endogenous group formation and program participation. Results show that peers significantly affect all four of these dimensions of female bargaining power. We also develop a conceptual framework that combines the Nash bargaining framework with the demographic diffusion literature (Montgomery and Casterline, 1996) and identity utility (Akerlof and Kranton, 2010) to define three potential channels through which peer effects work: information, influence and identity. Finally, we provide suggestive empirical evidence of these channels by allowing the causal peer effect to vary in the characteristics of the woman to find that information, influence and identity affect bargaining power and child food intake in different ways.

The contributions of this paper are as follow: first, we quantify the effect of peer networks on household decision making suggesting the presence of peer effects beyond informational spillovers. Second, our estimates relax the commonly-made but restrictive assumption of separability of group formation and information flows by accounting for endogenous group formation. Third, we also relax the equally restrictive assumption of directed networks by estimating the impact of a participant friend’s empowerment on non-participant friends. The directionality assumption is key to identification in the presence of the reflection problem but is restrictive and can lead to significant overestimates. Since we are able to isolate the marginal effect of friends’ participation on non-participations, our identifying assumption is that participant friends influence their non-participant friends. Fourth, we define and provide suggestive evidence on three potential channels through which peer effects may work in household decision making: information, influence and identity.

Understanding the role of peer effects in determining female bargaining power and child food intake helps us better understand the determinants of household decision making. While it has been shown that empowering women can improve child outcomes, the factors determining female bargaining power are not completely understood. If peer networks affect bargaining power and child outcomes, whether positively or negatively, they need to be accounted for when designing and evaluating development programs. Understanding this relationship between peers, female empowerment and child outcomes may allow for a better targeting of development programs.

⁴Note that the first three of these dimensions, physical mobility, access to outside employment and actually working outside the household, are both proxies for and outcomes of empowerment, while the fourth, children’s food intake, is a pure outcome. By considering both proxies for and outcomes of empowerment, we aim to capture the range of peer effects in household decision making.

1.2 Literature on Norms and Household Decision Making

Economists often argue that since mothers invest more in their children than do fathers, men and women have inherently different preferences with regard to household resource allocation, and as a result bargaining power affects the allocation of household resources as well as labor supply decisions (Ghosh and Kanbur, 2008; Agarwal, 2001; Sahn and Stifel, 2002; Quisumbing and de la Brière, 2000). A woman with little bargaining power within the household gets a smaller share of the household's resources than a woman with more bargaining power (Phipps and Burton, 1998; Thomas, 1990). Further, household resource allocations can vary significantly depending on who makes the decisions: men spend more money on personal consumption while women channel a large share to their children's education and health (Kanbur and Haddad, 1994). Rather than assume that women are more altruistic than men, our causal model provides women an economic incentive to invest in their children. Second, our model explicitly describes the effect of peer networks on bargaining power and child welfare.

While the economic literature often ignores the role of networks in determining female bargaining power, the demographic diffusion literature has extensively studied the impact of social interactions on individual contraceptive use. *Social learning* and *social influence* describe how individuals act on information acquired from peers (Montgomery and Casterline, 1996; Munshi and Myaux, 2006). In this literature, social learning occurs when women obtain information about contraceptive methods from peers and family. Therefore, social networks provide information and help individuals gauge the quality of the information (Kohler et al., 2001). Social influence occurs when individuals act in similar ways to avoid conflict within the social group. Networks also work through identity, providing examples to encourage individuals to copy peers' behavior (Behrman et al., 2002). Networks thus provide the set of peers to whom we compare ourselves and relative to whom we define our well-being (Akerlof, 1980).

Few papers have linked the theoretical advances of the contraceptive-use diffusion literature with the female bargaining power literature. To our knowledge no other paper has used self-reported networks in studying the determinants of female bargaining power and child food intake. Second, to our knowledge, no other paper has empirically explored the mechanisms through which self-reported peer networks affect female bargaining power. Can peer networks increase women's bargaining power and thereby improve child welfare? In this paper, we examine the impact of more empowered peers on a woman's say in household decision making, and thus on the food intake of her children.

2 Uttarakhand and The *Mahila Samakhya* Program

2.1 Background on Uttarakhand

Following decades of local demand for a separate state, Uttarakhand was carved out of the state of Uttar Pradesh in November 2000. Small, scattered villages without access to roads pose challenges to the state's development. Most villages are remote and many lack basic infrastructure such as schools and hospitals. Households generally engage in subsistence-type agriculture, although the state also supplies migrant labor to Delhi and other large towns. The literacy rate in Uttarakhand is 72 percent, lower than the national average of 80 percent. However, the state is also relative wealthy: in 2005-06, only eight percent of Uttarakhand households fell in the poorest wealth quintile nationally (IIPS and ORC Macro, 2007).

Uttarakhand has a large Hindu population— 85 percent as compared to 80 percent for the entire country (Census of India, 2001), with 18 percent belonging to Scheduled Castes and Tribes.⁵ Caste hierarchy is strictly maintained in Uttarakhandi villages, and most interactions are limited to members of the same caste. Villages are clusters of houses that are isolated from other villages by the hilly terrain, further limiting contact with others.

Villagers rely on the forest for firewood, water, and grass to feed livestock, while soil erosion threatens farmers' livelihood. As a result, Uttarakhandi people have long been associated with an active interest in natural resource management. The *Chipko* movement of the seventies is perhaps the most famous example in which Uttarakhandi villagers, and women in particular, literally hugged trees to prevent felling.⁶ Villagers have also protested the development of resorts and the diversion of water sources to richer communities.

2.2 The Status of Uttarakhandi Women

Alcoholism and resultant domestic violence are common problems in Uttarakhandi families. Almost forty percent of Uttarakhandi men consume alcohol, compared to the national average of 32 percent, and more than a quarter (26 percent) of all Uttarakhandi women have experienced physical violence (IIPS and ORC Macro, 2007). Only 18 percent of these women— or about five percent of the overall population— have sought help to control or end the violence. Uttarakhandi women thus not only have little say in their household, but also frequently suffer from abuse.

Uttarakhandi women also tend to have very few social interactions outside the immediate family. Firewood and water collection are women's tasks and often consume more than half the day. The remoteness of the region and lack of good roads combined with stringent social norms mean that once married, women are

⁵The Constitution of India categorizes the lower castes and tribes as Scheduled Castes and Tribes and provides them special protections and rights to help overcome the effects of discrimination by higher castes.

⁶The Hindi word *Chipko* means to stick.

unable to visit friends or even parents regularly. As many as 47 percent of Uttarakhandi women reported not having the final say on visits to family and friends (IIPS and ORC Macro, 2007). Field tests and the data suggest that women's lives are defined by their husbands, children, and in-laws, and they seldom participate in the political process, even at the village level. This state of isolation and ignorance, accompanied by constricting social norms restrict women to the narrow spheres of family and housework.

2.3 *Mahila Samakhya* in Uttarakhand

Mahila Samakhya is a women's empowerment program that started in what is now Uttarakhand in 1995. The program covers 2,416 villages in six of thirteen of Uttarakhandi districts. More than 42,000 women participate in this program, and over 2,500 girls have been educated in its centers. The program focuses on formal and informal education as the means to empowerment. Literacy camps, adult education centers, and vocational training enable participants to earn an income primarily through artisanry and store-keeping. In addition, the program provides special education on resolving domestic disputes and conflicts within the community. However, program rollout is not always straightforward. Local men sometimes resist the program and prevent their wives from participating. As a result, initially only a few women may participate, but as others see the benefits of participation, they muster up the courage to participate despite family opposition. Further, as the family— chiefly husbands and in-laws— see the benefits from participation, particularly through enhanced employability and increases in household income, they reduce opposition to the program over time.

Village- and district-level meetings allow participants to step outside their homes and villages, making their lives less solitary. Participants meet women from other castes and religions, which expands their peer networks and lets them engage in conversation not pertaining to domestic chores and family. The semi-formal and well-structured nature of these interactions facilitates dialogue. The information provided by *Mahila Samakhya* as well as that exchanged within the newly-expanded networks may help change social norms. The learned vocational skills allow participants to engage in income-generating activities. In particular, respondents are encouraged to acquire identification cards that enable them to participate in the government's National Rural Employment Guarantee Scheme (NREGS). NREGS guarantees at least a hundred days of paid work to the rural poor. Participation in NREGS provides these women an income, which can increase household bargaining power. Changed social norms and the ability to earn an income also enable these women to have greater physical mobility. Few other papers study *Mahila Samakhya* but they find positive impacts on female empowerment and social capital from participation in the program (Janssens, 2010; Kandpal et al., 2013). Finding evidence that *Mahila Samakhya* helps empower rural women by providing them better access

to the NREGS scheme, as well as increasing their physical mobility and political participation, Kandpal et al. (2013) further attempt to disentangle the program’s mechanisms, separately considering its effect on women who work, and those who do not work but whose reservation wage is increased by participation. In doing so, they find significant spillover effects on non-participants relative to women in untreated districts. It finds consistent estimates for average treatment and intent to treat effects.

3 The Causal Mechanisms

We hypothesize that *Mahila Samakhya* has two effects on female empowerment: one is the intended treatment effect of the program on participants, and the other is the peer effect that may affect non-participants as well as participants. The program treatment effect works through education, while the peer effect works through the spillovers of social networks of both participants and their non-participant friends. Having participant friends may, for instance, expand the perceived feasible set for participants, and through support from more empowered friends, may enable even non-participants to allocate more resources to their children. As more and more women are directly or indirectly affected by the program, *Mahila Samakhya* may indeed change the norm faced by all women in the village. The effect of participation in *Mahila Samakhya* can thus be summarized as follows: the program (1) exposes women to new information, leading to social learning, (2) works through social influence to ease constraints placed by norms, and (3) increases the identity utility received from belonging to a group.

Social Learning

Participation expands peer networks and access to information. In interviews, participants reported not even knowing five people outside their families prior to participation in the program. *Mahila Samakhya* introduces them to many more women, and through them to information on the opportunities and facilities available to women. Social learning can help remove the constraints placed by norms so women have more choices. A woman can learn new information from her peers. She may not have realized certain choices were available to her (for instance, the ability to study or work). This effect can be thought of “as expanding the set of choices known to the woman” (Montgomery and Casterline, 1996, p. 158). Further, the outcomes of the educational and employment choices made by her friends provide an “empirical demonstration of the range of consequences that can follow from the adoption of a particular choice and may thereby shape the woman’s subjective probability distributions” (Montgomery and Casterline, 1996, p. 158). Such learning is not restricted to close friends and can occur through “weak ties” (Granovetter, 1973), such as the ties with program participants from other villages.

Information about new opportunities can also be beneficial for women who cannot necessarily adopt those new opportunities themselves. Thus, the information of opportunities can be valuable for its own sake. For instance, one interviewed participant said that just knowing that women were successful lawyers, officers, teachers, and entrepreneurs changed her outlook on life. The information caused her to want to earn an income and be more self-reliant. This effect of information is consistent with the finding that urban Indian women with access to cable television were more empowered than those without cable television (Jensen and Oster, 2009).

Social Influence

Strong networks provide support groups that influence individual behavior and may increase the woman's power within her household, or alternatively, reinforce restrictive social norms. Individuals also learn from and are influenced by friends. Observing peers adopt new behaviors influences a woman's behavior because she trusts her peers and their judgment. Participants have more opportunities to interact with their peers, especially away from home. They develop a stronger network that can support them if they face domestic violence, or help change the household resource allocation. A woman with no support group may remain in the status quo for fear of being ostracized.

By organizing women into support groups, the program can increase their power within the household and community without fear of social sanction. The support group also intervenes directly when a participant's family refuses to improve its treatment of her. In field tests, a participant reported that her *Mahila Samakhya* network intervened when her husband and in-laws did not allow her to feed her daughter as well as her son. Another respondent said that her husband's treatment of her improved after she joined *Mahila Samakhya* because he was worried that program officials would intervene in his domestic life and shame him in the village.

Identity Utility

As well as improving connections with existing peers, *Mahila Samakhya* alters peer sets by expanding networks. The program changes the participant's relative set of peers so that the people she compares herself with are now more educated and have less traditional attitudes about women's role in society. In initial interviews, respondents often talked of the pride they felt in being program participants, and how they were happier because of the changes in their peer network. Non-participants have weaker ties to peers, hence their identity utility from belonging to a network is lower than that of participants. Peers behave like one another not only to avoid conflict and to coordinate with each other but also because they gain identity utility from being insiders in the group (Akerlof and Kranton, 2010). Identity is endogenous and thus identity utility is influenced by changes in the reference group.

A critical mass of empowered, educated, and mobile women can change the village culture. Participants told us that before joining the program they faced a constricting social norm, reinforced by the village culture. They could not work, were barely educated, had little say in the resources allocated to their children, and were told to discriminate against daughters. Their identity was always subsumed in their husband’s, brother’s, father’s, or in-laws’ identity. After participating in *Mahila Samakhya* and interacting with other participants, women realize they have their own identity, that they can work if they want to, that they should study, and that they can influence household and community decisions. In the long run, as more people invest in their children, and investments become more equitable between the two sexes, the village culture will reflect the new patterns in investment.

The question then arises, why do social norms that harm individuals persist in the absence of an intervention like *Mahila Samakhya*, and how do network-based learning and influence interact with such norms? Akerlof (1980) notes social norms disadvantageous to individuals may persist for fear of social sanction by the group against the individual trying to challenge the social norm— social influence at work. Further, people may not want to be outliers because of a negative feedback loop resulting from the social relativism of others. Program participants often reported being unsure what others would say if they tried to stand up to their in-laws or stop their husbands from hitting them— “We did not want to risk being different.” However, the program provides an in-built support group to help them challenge the status quo.

4 Model

In this section, we present a theoretical model that concretizes the causal mechanisms described above. To start, we model the husband and wife as playing a cooperative Nash bargaining game. If the bargain breaks down, the husband and wife each receive disagreement utility, which is lower than what they would have received if the bargain had been successful (McElroy, 1990; Lundberg and Pollak, 1996). The standard household Nash bargaining model does not account for the role of networks in determining disagreement utility, nor for the effects of identity utility or social learning and influence on the outcome of the bargain. The disagreement utility is simply each spouse’s intertemporal utility if they remained single or if they were non-cooperating in marriage, and depends on the spouse’s own earning potential and the partner’s earning potential as well as on the non-cooperative equilibrium outcome of investment in children.

To incorporate networks into the Nash bargaining model, first, we model the adults as making a joint decision by maximizing the generalized Nash product, \mathbf{x} , comprising a private good c , leisure l , and a public good reflected by investment in children r . Each adult’s say in the household is represented by the exponents α and β , which sum to one and reflect the relative levels of bargaining power captured by husband and wife.

These exponents can depend on social norms, and can change over time to reflect more equitable norms. The bargain leads to optimal values of the bundle for each adult, \mathbf{x}^* . These consumption bundles belong to a set $\{X\}$ of all possible choices of \mathbf{x} . In period one, the adults choose their optimal \mathbf{x} for each time period to maximize the current period utility and expected utility in the next time period.

To model constraints imposed by social norms, we make the set of choices $\{X\}$ known to an individual a mapping of the set of choices chosen by his/her peers X_N . The set of choices, X_N , reflects choices made by an individual's peers and is the union of all the consumption bundles previously chosen by the peers.⁷ X_N is thus the subset of peers' choices that have been observed by or are otherwise known to the maximizing individual. We model X_N as only the observed or known past choices made by peers because the maximizing individual may want an "empirical demonstration" (Montgomery and Casterline, 1996, p. 158) of the outcome of any given choice and may wait to see this outcome before considering the choice to be feasible. The more diverse a woman's network, the larger is X_N , and the more empowered her peers, the greater is her set of high-utility (to her) options in the choice set.

Second, we represent the effect of networks by assuming individuals receive utility by being better off than their peers, and suffer a penalty to utility if they are worse than their peers. The additional bonus or penalty utility is denoted as U_r , and is a function of the average utility of the social network, N . We thus add identity utility U_r from the relative set or network N , to each utility function. Since male and female networks are different, we use the subscripts m and f to denote these differences. Identity utility can be negative if the individual is worse-off than her reference group, and positive if she is not worse off than her peers. Note also that identity utility increases in the strength of ties. The third change to the basic Nash bargaining problem reflects social influence on individual bargaining power by making disagreement utilities V a function of networks because networks can provide support in domestic disputes and limit the potential for social sanction.

The household thus faces the following maximization problem with respect to the constraints on \mathbf{x} described above, and a full-income budget constraint.

$$\begin{aligned} \max_{\mathbf{x}_{f,1}, \mathbf{x}_{m,1}} & [U_f(\mathbf{x}_{f,1}) + EU_f(\mathbf{x}_{f,2}) + U_r(N_f, \mathbf{x}_{N_0,f}^*) - V_f(N_{f,1})]^\alpha \\ & \cdot [U_m(\mathbf{x}_{m,1}) + EU_m(\mathbf{x}_{m,2}) + U_r(N_m, \mathbf{x}_{N_0,m}^*) - V_m(N_{m,1})]^\beta \end{aligned} \quad (1)$$

⁷The set X_N does not include choices available to peers but not chosen by them because the maximizing individual only observes his/her peers actions. This set also does not include choices made by friends but not known to the maximizing individual. For instance, the participant who said that knowing women can be lawyers, doctors etc. empowered her did not say that knowing that women know they can be lawyers also empowered her. Therefore, we assume only the observed \mathbf{x}^* matters. Although women with access to televisions may see women on cable shows being employed as lawyers, etc., actually meeting a woman engaged in professional employment is likely more salient and has a greater impact.

$$\mathbf{x} \in \{X\} \quad (2)$$

$$X = f(X_{N_0}) \quad (3)$$

$$X_{N_0} = \bigcup \mathbf{x}_{N_0}^* \quad (4)$$

The household's full-income budget constraint (FIBC) derives from the individual budget constraints faced by the man and the woman. Each gets utility from consuming the vector of goods \mathbf{x} in each time period. The vectors \mathbf{p}_m and \mathbf{p}_f reflect the prices faced by the man and the woman, including wages. The prices associated with the private good c and leisure l are p_c , w_f for the woman, and w_m for the man. We model the public good r as the numeraire, hence the associated price is one. Since women have a lower expected wage and a longer life expectancy, they have an economic incentive to invest more in their children. Hence, the woman's optimal choice of r is greater than the man's optimal choice. The woman's share of the household's resources, θ , is parametrically defined by α and β ; these shares are given by norms and are not a bargaining outcome. The woman's FIBC looks as follows:

$$\mathbf{p}_f(\mathbf{x}_{f,1} + \mathbf{x}_{f,2}) \leq \theta(\alpha, \beta) \left[\sum_{t=1,2} Y_{f,t} + (Y_{m,1} + \rho Y_{m,2}) + E(T_f) + \rho E(T_m) \right] \quad (5)$$

where ρ represents the probability that the woman is married in period 2. $E(T)$ refers to the expected transfers from children. The man's FIBC looks as follows:

$$\mathbf{p}_m(\mathbf{x}_{m,1} + \mathbf{x}_{m,2}) \leq (1 - \theta(\alpha, \beta)) \left[\sum_{t=1,2} Y_{m,t} + (Y_{f,1} + \rho Y_{f,2}) + E(T_m) + \rho E(T_f) \right] \quad (6)$$

Adding up the constraints in equation 5 and equation 6 yields the full-income budget constraint faced by the household (equation 7).

$$\begin{aligned} & \mathbf{p}_f(\mathbf{x}_{f,1} + \mathbf{x}_{f,2}) + \mathbf{p}_m(\mathbf{x}_{m,1} + \mathbf{x}_{m,2}) \leq \\ & \sum_{t=1,2} Y_{m,t} + \theta(\alpha, \beta) \left[\sum_t Y_{f,t} - \sum_t Y_{m,t} \right] + \theta(\alpha, \beta)(Y_{m,1} + \rho Y_{m,2} - Y_{f,1} - \rho Y_{f,2}) \\ & + (Y_{f,1} + \rho Y_{f,2}) + [E(T_m) + \rho(E(T_f) - \theta(\alpha, \beta)E(T_m) - \theta(\alpha, \beta)\rho E(T_f))] \end{aligned} \quad (7)$$

In this model, parents invest in children for consumption smoothing purposes. An increase in education

raises bargaining power, and potential household and individual income, which have different effects on investments in children. Education raises investment in children only so far as higher bargaining power outweighs the countervailing effect of increased potential individual income. Education no longer increases investment in children once the increase in bargaining power is smaller than the increase in potential income. However, due to consumption smoothing, the increased differential in current versus future household income increases demand for future transfers, and thus investment in children. As long as women live longer than men and have lower average income, an increase in women’s educational attainment will thus increase investment in children.

Consider the husband and wife’s utility to be the outputs produced by the household; these outputs are a function of the utility from labor allocation, consumption, investment in children, and participation in networks. A household utility possibilities frontier (UPF) gives us all the feasible pairs of husband and wife utility production. Following the earlier discussion, the model yields four ways in which networks affect female empowerment: (1) Levels of and changes in bargaining power can affect the observed equilibrium. If a woman does not have much bargaining power, the equilibrium will result in greater utility to the husband than to the wife. (2) Not knowing about all the choices or feasible levels of utility might constrain the equilibrium to a subset of the full UPF. The social norm might constrict the whole household, but women differentially than men so they do not realize that certain high levels of utility are attainable. (3) Finally, if the woman’s relative set of peers follow the social norm, i.e. do not work and have little or no education, the household may be on a lower UPF than it would otherwise. (4) Over time, the social norms might change as a result of more women participating in *Mahila Samakhya*.

4.1 Social Learning

Social learning enables *Mahila Samakhya* to change the social norm through the “expansion of the set of choices available to women” and the “the empirical demonstration of the range of consequences” from adopting certain behaviors (Montgomery and Casterline, 1996, p. 158). Figure 2 illustrates how the constraints placed by the program can restrict the UPF to a small portion of the true frontier. Point A is a possible equilibrium outcome, at which the husband’s utility is U_A^m and the wife’s utility is U_A^f . However, neither spouse knows the extent of the true UPF because social norms constrain their choice sets to less than the full feasible set. Constraints on the husband restrict the frontier along the x-axis, while constraints on the wife limit the frontier along the y-axis. Point B is on the same UPF but is not available because the higher level of female utility it represents is ruled out by social norms. The indirect network effect of *Mahila Samakhya* removes the constraints— initially only for the woman, but eventually also for her husband. Point B now

becomes feasible. A move to point B would increase her utility ($U_B^f > U_A^f$) and decrease her husband's utility ($U_B^m < U_A^m$). While this discussion treats the bargain as a zero-sum game, newly-expanded networks can in fact improve the entire household's utility by empowering the woman to earn an income and thus expanding the household UPF.

4.2 Social Influence

Figure 3 represents the household's utility space, a UPF, and the equilibrium resulting from the husband and wife's choice sets. The dashed lines represent the husband and wife's levels of disagreement utility. If the bargain breaks down, they receive V_m and V_f , represented in utility-space by the intersection of the two dashed lines. The disagreement utilities place lower bounds on the UPF with respect to the x - and y -axes. Now consider the situation in which a woman near the disagreement utility joins *Mahila Samakhya*, and the resultant support group intervenes in her domestic situation and increases her disagreement utility so that she is better-off even if the bargain breaks down. Also consider the case in which her husband's disagreement utility decreases because the support group forces him to improve his treatment of her. The new disagreement utilities, represented by the dotted lines, expose a previously-unattainable part of the UPF that represents higher utility to the woman, and limits part of the UPF associated with lower utility to her.

The anecdote of the woman who said her husband's treatment of her improved after she joined the program because he was afraid of being shamed in the village illustrates this effect on bargaining power. Further, by providing support groups the program decreases the woman's fear of ostracism and empowers her to change her situation within the household. Social influence thus enables the woman to change the available UPF to include better outcomes for her and restrict the possibilities that make her worse off. The educational effect of the program also increases the woman's disagreement utility because knowing about better job prospects and having more marketable skills raise her expected wages and thus increase her bargaining power. Note that the observed outcomes in the event of a breakdown in the bargain depends on social norms, as reflected by parameters α and β as well. Participation in *Mahila Samakhya* changes both the level of disagreement utility as well as α and β .

4.3 Identity Utility

The third effect of networks might be to shift the UPF available to the household. The woman's utility is a function of the attitude or actions of her relative set of peers that she observed in the previous period. She defines her well-being relative to this set, and gains identity utility from behaving like the people in the set (Akerlof and Kranton, 2010). If these peers have traditional attitudes and adhere to the social norm

although it discriminates against them, their ties are likely to be weak, hence the woman's gain in identity utility is also low. Such a relative set leaves little scope for social learning and may cause the woman's household to be on a lower UPF than they can attain. However, identity also has a relative component. The woman gains utility from being at least as well off as her peers, and loses utility if she is worse-off than them. By observing other women holding jobs and being educated, the woman is motivated to make similar changes in her life.

If the program strengthens a woman's peer network, she stands to gain identity utility. The program also introduces her to more empowered women, who likely receive a greater share of the household's utility. She now needs a higher level of utility than before in order to be as well off as her peers. At point A in figure 4, without accounting for identity utility, the woman receives U_A^f in utility. However, her peers have some arbitrarily chosen higher level of utility, U_r^1 , which effectively shifts back her UPF. After accounting for this loss in utility, the woman only receives $U_A^{f,r}$. The loss in utility from U_A^f to $U_A^{f,r}$ represents the negative identity utility to the woman from being worse off than her peers.

If the equilibrium occurs at point B, the woman is better off than her peers, which is represented by a shifting out her of her UPF. The gain in identity utility means she effectively receives $U_B^{f,r}$, which is greater than U_B^f . Now if the woman's relative set changes because of *Mahila Samakhya* and the new relative set has higher utility, U_r^2 , the woman needs a greater gain in utility to be as well-off as before. Now, some parts of the UPF (between X and Y on the y -axis, where she was better-off than a less empowered relative set) shift in because she is worse off than her new relative set. Stronger networks from participation thus lead to a greater change in identity utility than a weaker network.

4.4 Social Norms

Even without the constraints, a move from A to B would not be observed if the woman's bargaining power was very low. The household's relative value of a woman's happiness increases in the woman's bargaining power, hence the slope of the indifference curve at the point of tangency to the UPF is the ratio of bargaining powers, BP_f/BP_m . To observe an equilibrium where the woman gets a larger share of utility, the value of the exponent α must increase. The values of α and β depend on social norms. If the culture is such that women do not get a large share of utility, then α will continue to be low. By changing endogenous individual characteristics like education and mobility, *Mahila Samakhya* changes the norms. Over time, exposure to the program can result in a new culture where the exponents are similar in magnitude, reflecting a more equal distribution of bargaining power.

In this framework, the peer effect of the program works through networks to change the woman's bar-

gaining power, increase the feasible set of choices available to her, and change the UPF that is attainable to her household. The model presented here yields testable hypotheses.

5 Data

Household data from India do not include information on self-reported networks, and preclude an analysis of the effect of networks on child welfare. Researchers have used caste to proxy for peers in India because caste is a strong signifier of networks (Munshi and Rosenzweig, 2006), but there may be networks of varying strength within castes. As a result, we collect data from the north Indian state of Uttarakhand on women’s peer networks, instruments for social learning, influence, female power, and their role on child nutrition outcomes. In addition, we also collect data on participation in *Mahila Samakhya*. Program centers have been present in Uttarakhand villages for periods lasting anywhere from three months to five years, allowing us to use time-variation in exposure to the program to identify its impact on networks and child nutrition.

Our data are from six of thirteen districts in Uttarakhand (the state of Uttarakhand is represented by the cross-hatched region in Figure 1 districts), four with the program and two without. The survey districts are represented in the inset of Figure 1 with a dotted pattern. The four districts with a thick border and dotted patterns are program districts. The two dotted districts without a thick border are non-program districts. Villages within the sample were randomly-chosen. We designed the survey to trace self-reported networks, and hence implemented restricted snowball sampling.

In each village, we interviewed a randomly-chosen woman and asked her to list five people with whom she was in contact on a regular (daily or weekly basis). We then conducted follow-up interviews with two randomly-selected women from these five friends. We asked each of these two follow-up interviewees about five of their closest friends, and interviewed two friends each. Thus, starting with one woman, the sampling strategy yielded a network of seven. The final sample is of 487 women belong to 72 networks across 69 villages; thirteen networks spanned more than one village. In seven cases, friends of friends listed the first woman as a friend; the analysis below drops these seven cases. Chandrasekhar and Lewis (2011) estimate large biases, of up to 90 percent, when using random draws or top coding to sample peer networks. When field testing the questionnaire, over 95 percent participants reported regularly communicating with fewer than five people outside their families, particularly prior to program participation. As a result, five appeared to be an effective upper limit on network size in our sample. Indeed, as figure 5 shows, 391 of the 487 respondents in our sample reported having three or four friends (187 reported three, 204 reported four), with only 42 women reporting five friends.⁸

⁸One concern we had during the survey was that when respondents observed that we would ask several questions about each

5.1 Summary Statistics

As Table 1 shows, the average woman in our sample was 32 years old, while her husband is 38 years old. She married at age 19 and has 9 years of education, while her husband has an additional year of education. The average age of her sons is 8, and that of her daughters is 6. The average woman's house has three rooms and electricity. Table 3 tells us that 78.17 percent of the program participants but only 58.82 percent of non-participants could leave the house without permission. Similarly, while 68.02 percent of participants have NREGS identification cards, only 48.94 percent of non-participants do. Table 4 shows that participants' children also consume more rice, lentils, and dairy than non-participants children.

As established in Chapter 3 of this dissertation, participants might select into *Mahila Samakhya*, but evidence suggests that the program is not targeted by geographic area in any meaningful way. Further, poorer participants neither select into the program nor are they targeted based on indicators of wealth (number of rooms, electrification, access to improved toilet facilities, and nature of the construction materials used for the floor and walls of the house). As a result, our identification strategy involves accounting for endogenous program participation.

6 Identification Strategy

The empirical analysis occurs in two steps: first, we identify causal peer effects. We instrument for the endogeneity of program participation using exposure to the program, and for the endogeneity of networks using the number of other women in the village with a similar time to collect water and the number of other women in the village of the same caste. Second, we study the mechanisms through which the peer effects work: social learning, social influence, identity utility, and changing social norms. Note that peer effects can work directly on participants themselves, and also indirectly through the friends of participants. As a result, the change in reference group afforded by the program is essentially a peer effect.

6.1 Endogeneity of Program Participation

Because participation in *Mahila Samakhya* is most likely endogenous, we consider the number of years a participant has lived in a village with *Mahila Samakhya* as an adult, while separately controlling for age and village. We use the threshold of 16 for adulthood because program participants can be no younger than 16 years of age. This variable tells us the potential years of exposure of an adult to the program, and is thus correlated with participation. Further, any effect of this variable on female empowerment likely

friend, they would only list a one or two friends instead of the true number. To avoid such bias, at the start of the interview, we simply asked respondents to list the names of their friends and asked detailed questions about these friends further on in the survey.

works through participation in the program, rather than directly. This variable is driven by the year the program started as there is little migration among married women in the region. Since women often migrate at the time of marriage, the exposure to the program might have started in their natal village through a participant friend or parent. However, we do not know whether the woman’s natal village had the program, so migration at the time of marriage might lead to measurement error, which in turn would bias results downwards. Nonetheless, given that unmarried women do not participate in the program, exposure would have had to be indirect, and thus the resultant bias would be small.

6.2 Identifying Peer Effects

With observational data on outcomes y of an individual i and attributes x , a researcher seeking to understand the impact of i ’s social network may wish to estimate the following model (Manski, 1993):

$$E(y_i|x_i) = \alpha + \beta\bar{y} + \gamma\bar{x} + \delta x_i + \epsilon_i \quad (8)$$

where \bar{y} is the of average outcome in the network and \bar{x} represents the network average of attribute x . In a model linear in x and y , it is impossible to identify β and γ because \bar{y} also depends on \bar{x} . In this context, Manski (1993) presents three hypotheses that may explain the observed similarities in the behavior of friends.

(1) Correlated effects occur when people act alike because they face a similar environment or have similar characteristics. (2) Contextual effects describe the fact that individuals are more likely to act in a given way depending on the distribution of group members’ characteristics. (3) Endogenous effects represent the phenomenon where the group affects individual behavior through social interaction. The third effect is key to identifying the causal network effect, but may still be confounded by the reflection problem, i.e. does i influence the group’s behavior or does the group influence i ?

Much of the literature following Manski has focused on the econometric issue of separating the causal peer effect from that of correlated unobservables (Conley and Udry, 2010; Miguel and Kremer, 2004; Foster and Rosenzweig, 1995; Bandiera and Rasul, 2006). Two ways of disentangling these effects are to (1) randomize the networks (Sacerdote, 2001; Zimmerman, 2003; Duflo and Saez, 2003) or (2) randomize an intervention or new technology at the friend-level (Banerjee et al., 2012; Oster and Thornton, 2012; Godlonton and Thornton, 2012; Kremer and Miguel, 2007). However, since neither networks nor information flows are exogenously determined in practice, the policy implications of such approaches are unclear. Our identification strategy attempts to estimate causal peer effects using an instrumental variables approach with a spatial weighting technique (Kelejian and Prucha, 1998) to identify causal peer effects on behavior, using pre-existing, endogenously-determined networks and information flows. The Kelejian and Prucha (1998)

estimator can be written as follows:

$$Y = \alpha + \gamma WY(WWX) + \epsilon \tag{9}$$

Y is a vector of outcomes, X is a vector of characteristics, W is a row-normalized 0/1 matrix of friends. The identifying assumption is that a spatial unit is only influenced by neighbors of its neighbors through the mutual neighbor. Recent extensions of spatial econometrics to networks have relied on the Generalized Spatial 2SLS estimator by using partially overlapping networks (Lee, 2007; Bramoullé et al., 2009; de Giorgi et al., 2010) and can be written as follows:

$$Y = \alpha + \beta WX + \gamma WY(WWX) + \epsilon \tag{10}$$

The exclusion restriction here is that friends of friends (i.e. those individuals that are in your reported friends' network, but neither you nor the friend of the friend listed each other as friends) only affect behavior through the mutual friend. Given data on pre-existing networks, this extension of the GS2SLS estimator thus relies on two key assumptions: the first is that this exclusion restriction holds and the second is that group formation is separable from information flows. A limitation of our data (and most available datasets, including those used earlier) is that we do not know entire networks, simply five of the woman's friends. We showed above that this top code of five does not appear to be restrictive, therefore the exclusion restriction is likely to hold in our case. Further, we use instruments identified during fieldwork to account for endogenous group formation, which crucially allows us to relax the assumption of separability of group formation and information flows. In effect, then, while the original GS2SLS is a Generalized Least Squares estimator, in this paper, we instrument for both the weights matrix W and the explanatory variables X . Our regression equation can be written as follows:

$$Y = \alpha + \beta X(Z) + \gamma WX(WWX(VVZ)) + \epsilon \tag{11}$$

Z is the vector of instruments. Our instruments for group formation are: number of women of the same caste in the village and number of women with the same time to collect water (normalized to the village mean). While the intuition behind the caste instrument is straight forward and exogenous, the water collection instrument requires further explanation. Villages in the survey region tend to have multiple water sources. Since the houses within a village are clustered, women face very similar times to collect water, with the variation being driven by topography: some women choose to go to more proximate water sources, which maybe involve a steeper climb, while other walk a longer distance if the walk is less hilly. Thus, for any

given village, women with similar times to collect water are likely to go to the same source. We treat women with times to collect water within one standard deviation of each other as potential friends. Water collection tends to take about 24 minutes each day, for participants and non-participants alike. We also treat women of the same caste within a village as potential friends.⁹ We then generate two network weights matrices: one which identifies all self-reported friends, and a second that identifies all potential friends using the caste and time to collect water instruments. To generate instruments for the true weighted participation of friends, we multiply the caste- and water-time-based weights matrices with the exposure to the program vector. These network-weighted instruments thus reflect the average number of years all potential friends have lived, as adults, in a village with the program.

Even after identifying the causal effect, the reflection problem remains to be accounted for. While Lee (2007); Bramoullé et al. (2009); de Giorgi et al. (2010) assume that social networks are directed, i.e. that the individual listing friends is the one being influenced by their peers, while the peers are not equally influenced by the individual listing them, we attempt to relax this assumption by estimating the marginal effect of friends' participation on non-participants. The identifying assumption is thus that, given existing social norms governing household decision making, the *Mahila Samakhya* program only affects a non-participant's household bargaining power and children's food intake through her participant friends. Thus, our estimates of the effect of friends' participation on non-participants is likely not contaminated of the reflection problem. However, correlated effects continue to be a source of bias in our analysis, particularly in the presence of proxy-reported peer behavior (Hogset and Barrett, 2010). Since we conduct follow-up interviews with friends and use these primary data, our data do not have measurement error from proxy reports. The standard errors reported below are also clustered at the network level, further reducing contamination from correlated effects at the network level.

6.3 Decomposing the Mechanisms

In the section on causal mechanisms, we described four major channels through which peer networks and *Mahila Samakhya* affect female bargaining power and child welfare: social learning, social influence, identity utility, and social norms. Below, we describe the proxies that use to measure each of these mechanisms (summarized in Table 12), and the expected signs on the corresponding right-hand side variables (summarized in Table 13). Since we measure the mechanisms using proxies, we cannot rule out that the proxies for a mechanism might be contaminated by observables or unobservables correlated with one of the other mechanisms.

⁹ Kandpal and Baylis (2013) show that the *Mahila Samakhya* program also serves to diversify peer networks, and that participants tend to have significantly more friends from other castes than do non-participants. Therefore, by using caste to instrument for self-reported friends, we may underestimate the effect of the program; nonetheless, we are able to report significant peer effects.

However, as outlined below, we posit that these proxies primarily pick up the mechanism they are intended to measure. Further, we test the robustness of results using different proxies for the mechanisms; results are robust.

Social learning removes constraints on the PPF: Intuitively, these constraints will be more binding on women who do not have much access to information before the program. Our hypothesis is that women with little education are less exposed to information than those with five or more years of education, and thus have more to gain through social learning. Hence, we measure this effect using low education, and interaction with own participation and friends' participation in *Mahila Samakhya*. We define low education as four or fewer years of education. Most women in our sample (72.24 percent) had at least five years of education. As a result, we expect the interactions of low education with own and friends' participation to have positive effects on female bargaining power and child food intake outcomes, while low education by itself is likely to have a negative effect on the outcomes.

We model social influence as increasing disagreement utility, which most affects women whose agreement utility is close to their actual disagreement utility in the event of a bargaining breakdown. These women are likely those with particularly low initial bargaining power, which we proxy for using the spouses' age ratio. Women become part of strong support groups when they participate in *Mahila Samakhya*, which increases their disagreement utility in the event that they do not reach a successful bargain with their husband. Women who have very low initial bargaining power, but now participate in *Mahila Samakhya* may gain more from social influence than those with higher initial bargaining power. However, since bargaining power itself is an outcome of program participation, we need to use a measure of bargaining power that is likely to remain unchanged by participation. We use the spousal age ratio to capture this initial bargaining power effect. We expect the interaction of program participation and the spousal age ratio proxy to have a positive effect on our outcome variables.

Identity utility from belonging to a group shifts out the PPF. Presumably the degree to which a woman cares about her social group's opinion will affect the potential utility gains from associating more closely with the group. We capture this effect of identity utility using whether a woman cares a lot about her friends' opinion of her (referred to here on as Friends' Opinion (Women)), and interacting this degree of care with her own participation and weighed participation. The more a woman cares, the greater the identity utility she gains from being part of her group of friends. Since we argue that participation in *Mahila Samakhya* increases a woman's identity utility, we expect the interaction terms between own and friends' program participation and caring about friends' opinions to have a positive effect on outcomes.

Social norms constrain women's behavior and their choice sets. The greater the influence of norms on the household, presumably the more are women bound by these constraints. We proxy for the strength of

the norms faced by a woman via whether the husband cares a lot about villagers' opinion of him (referred to here on as Villagers' Opinion (Men)), interacted with both her own and friends' participation. The more the husband cares about villagers' opinion, the more constraining are social norms, and so we expect a negative direct effect on outcomes. However, we expect own and friends' program participation to somewhat mitigate the effect of constraining social norms on individuals. Increasing the number of empowered women in the village also directly changes social norms if the norm is for women not to be empowered. Hence, the interaction terms with husbands caring about villagers opinion should have positive effects on outcome variables.

6.4 Dependent variables and mechanisms

We use three dependent variables for female bargaining power: whether the woman works outside the household, whether her name is on her household's NREGS identification card, and whether she is able to leave the house without permission to go to the market for routine purchases. Here, we describe which of the mechanisms we expect to be significant determinants of these measures of bargaining power. We also describe the effect of empowerment and peer networks on children's food intake since this paper also studies whether more empowered women in fact invest more in their children.

Working outside the household and access to NREGS: we expect having access to NREGS and the likelihood of working outside the household to be primarily affected by social learning and influence. Women might not know it is possible for them to work, particularly in the predominantly construction/ manual labor jobs offered by the NREGS. However, learning alone does not tell a complete story; even after learning that they can participate in NREGS, women often need support to get access to outside employment and certainly to start working outside the household. Indeed, several studies in South Asia find that a woman's access to employment outside the house significantly increases her household bargaining power (for a study in Bangladesh, see Anderson and Eswaran, 2009; for a study in India, see Rahman and Rao, 2004).

Being able to go to the market for routine purchases without permission: we expect social influence to be the dominant mechanism here, although social learning and identity utility are likely important as well. Women who participate in *Mahila Samakhya* have support groups so they do not fear ostracism by the local community for going out without permission. However, they also may not have realized that they could leave the house without permission, and only learned that they could from participating in the program. Finally, identifying as a "*Mahila Samakhya* participant" and identifying with the other (more mobile than average) participants might empower a woman to go to the market without permission.

Children's food intake: we consider the number of bowls of rice and dal consumed by each child in the

household in the past day. For food consumption, we expect learning to be the most important because women, particularly those with low education, may not know how much to feed young children. However, for the relatively expensive items like dal, influence and identity might have a more significant effect. Allocating more dal to children might mean the husband gets less food, which is more likely to happen if the woman feels more empowered to have a say in her household’s resource allocation decision because of the support from her friends. We also expect norms to be important because how much one’s children eat is likely affected by what other, perhaps older people in the village feed their children. The more the husband cares about the villagers’ opinion of him, the more likely children are to be well-fed. Finally, using household fixed effects, we look at the impact of having empowered friends on girls and boys’ food intake in the same household. Finding that women with more empowered friends feed their daughters more or better food than women with fewer empowered friends would be indicative of a peer effect that works through the intrahousehold bargain.

7 Results

As described above, we instrument for own participation using potential exposure to the *Mahila Samakhya* program, and weighted friends’ participation using the number of women in the village with similar time to water source and same caste interacted with the participation instrument. Table 5 presents the first stage results for own participation, while Table 6 presents the first stage for weighted friends’ participation, and Table 7 presents the second stage results from the causal peer effects estimation. The instrument diagnostics for both sets of instruments suggest they we are correct to worry about endogeneity of both own and weighted friends’ participations. The tests further suggest that the instruments are strong and that the structural equation is correctly specified.

In the first stage of the empowerment outcomes regressions, presented in table 5, women with a lower absolute value of spousal age difference (wife’s age minus husband’s age) are significantly more likely to participate, as are Brahmins. We also find that older women are significantly more likely to participate, while the coefficient was insignificant in the empowerment regressions. However, the effect of friends’ participation is insignificant on own participation. In all the first stage regressions for weighted friends’ participation, presented in table 6, both time to collect water and caste instruments are significantly and positively correlated with participation. In the regressions instrumenting for the interaction proxies that aim to capture mechanisms, the instruments (predicted own/friends’ participation times the mechanism proxy) are also significantly and positively correlated with the instrumented interaction term.

Causal peer effects on household bargaining outcomes are outlined in Table 7. These results tells us

whether own and friends' participation in the program increase female empowerment measures, while controlling for (1) the woman's personal characteristics, such as age, spousal age difference, years of education low educational attainment, (2) household demographic characteristics: the number and average age of the woman's children, whether the household is Brahmin, and whether the parents-in-law live in the household, and (3) a household-level wealth index (Filmer and Pritchett, 2001).

The results in table 7 are from the 3SLS (and thus instrumented) regression of own and peers' participation in *Mahila Samakhya* on the female bargaining power outcomes. These results show that participants are significantly more likely to work outside the household, more likely to have their names on NREGS cards, and more likely not to need permission to go to the market. Friends' participation in *Mahila Samakhya* also leads to an increased probability of working outside the household and not needing permission, but has a significant negative effect on having access to NREGS. The marginal .

The bargaining power regressions also tells us that friends' participation makes a woman significantly more likely to leave without permission; this effect is lower for women who are themselves participants. The greater a woman's identity utility—the more she cares about her peers' opinion of her (Friends' Opinion (Women))— the less likely she is to have an NREGS card. The more the husband cares about villagers' opinion (the more constraining are social norms on the husband and therefore on the wife), the less likely women are to have NREGS identification cards or to leave without permission. These results also tell us that richer women (those with electricity) are less likely to go out without permission, and that Brahmin women are less likely to have NREGS cards.

Table 9 presents the 3SLS results of own and friends' participation in *Mahila Samakhya* on children's rice and dal intake. In addition to the woman's personal characteristics, household demographic characteristics, and household asset index described above, the right hand side variables for these outcomes include the husband and wife's consumption of the corresponding food group. Results suggest that own participation significantly increases children's rice and dal consumption. Older women, and women closer in age to their husbands have significantly better-fed children, while Brahmin children eat smaller amounts of rice and dal. The wife's lentil and dairy consumption is not significantly associated with child's consumption while the more rice the husband eats, the more his children eat as well.

Table 14 presents marginal effects for female bargaining power. Of the potential mechanisms, social learning and social influence play the most important roles in female empowerment. Social learning is a key mechanism: women with low education are significantly more likely to go out without permission as a result of own and friends' participation. These are the women who stand to gain the most from the informational content of networks, and the fact that the program benefits them the most suggests that social learning is an important component of the peer effect.

Social influence also plays a major role in determining female empowerment, as own participation significantly improves both outcomes for women with greater initial bargaining power as measured by the spousal age ratio. In other words, program participation significantly increases the disagreement utilities of the participating women and empowers them. Identity utility and changing norms, while insignificant for NREGS card ownership, significantly improve empowerment as measured by the permission variable. Identity utility through own and friends' participation, in particular, increases the likelihood of a woman leaving the house without permission for the average woman, and for participants alone. Friends' participation also interacts significantly with the identity utility measure (importance of friends' opinion) for the average woman and the average participant. In summary, peer networks work through social influence and learning to significantly empower women.

Table 15 presents marginal effects for food intake mechanisms. Learning and influence through the program appears to be most important in the food intake regressions: children of women with low initial bargaining power (those with a greater spousal age difference) eat more rice and dairy due to their mothers' participation in the program. Identity utility significantly influences the intake of rice as the effect of caring about the friends' opinion is greatest for women with more participant friends. Binding social norms actually appear to improve child welfare, as the more the husband cares about the villagers' opinion of him, the more rice and dairy his children eat. The signs and significance levels of the husband and wife's rice, lentil, and dairy consumption is consistent with the OLS and base 3SLS results presented above.

The marginal effects presented in Table 15 tell us that on average, own participation significantly increases both rice and dal consumption by children, although friends' participation appears to slightly decrease lentil consumption. Both social learning and influence have significant positive effects on dairy consumption, suggesting that for relatively expensive non-staples, peer networks can have a sizable impact on children's food consumption. Social learning is also a significant determinant of rice consumption. Identity utility, through own participation also significantly improves rice and dairy intake for the average woman's child. Finally, as suggested by the base and mechanism regressions, social norms appear to help improve child food intake. In summary, social learning, identity utility, and social norms play important roles in improving child food intake.

7.1 Sensitivity Analyses

Falsification test

Our results suggest the presence of a causal peer effect based on our snowball sampling-driven identification strategy. However, what if these estimates were simply picking up other patterns in the data and not

actual networks? We conducted a falsification test by randomly assigning each woman in our sample to a network of six other “friends” and “friends of friends” and re-estimate the 3SLS equations. We find no statistically significant peer interactions among women that have been assigned randomly to a peer network which strongly suggests that the results reported in this paper are the result of causal peer effects and not non-observables in the data.

Instruments for endogenous group formation

We also tested the water collection instrument for group formation by dropping it from the estimation. This is a test of the qualitative evidence behind the instrument. Our results, while identical in size and direction, are more significant without the water collection instrument. Similarly, we dropped the caste instrument as well both instruments; while the results are similar in size and sign, the significance increases in both cases. All three specifications yield more significant estimates that are also larger in magnitude, thus highlighting the importance of controlling for endogenous group formation or risking upward biased estimates.

Interaction Terms with Brahmin Dummy

Since a large proportion of program participants are Brahmin, it may be that being Brahmin affects both peer effects and program participation. As a result, we also tried several specifications that included interaction terms of the Brahmin caste dummy with other right hand side variables. In the specifications using age of sons and time to collect firewood as instruments for participation, these interaction terms improved the Akaike Information Criterion (AIC), although the terms were never significantly different from zero. In the specification using the exposure to the program instrument, the interaction terms increased the AIC and remained insignificant. As a result, the specification we report below does not include the interaction terms.

Alternative Instrumental Variables for Participation

Initial interviews revealed that program participants often have older sons, and a longer time to collect firewood. As a result, we tried the age of sons¹⁰ and time to collect fuel as alternative instruments. Parents in-law and the husband can perceive leaving a young son at home as neglecting one’s duties, so women with young children are often unable to leave the house for extended periods of time, such as to attend program meetings. On the other hand, women who spend more time in the forest collecting firewood may feel more isolated and may be more interested in the community-building activities of the program. The 3SLS results using age of sons and time to collect firewood as instruments were qualitatively very similar to the ones

¹⁰For women with no sons, we set the age of sons to zero. We separately controlled for number of sons in all regressions.

presented above. However, we choose to highlight the results using the alternative instrument described above because it relies on program rules, and satisfies the exclusion restriction more clearly.

2SLS versus 3SLS

Finally, we estimated the 3SLS regressions using 2SLS and predicted participation. The results were qualitatively similar to the 3SLS results presented above. We focus on the 3SLS results because the 3SLS does not require estimating all instrumented variables on the same set of regressors.

8 Conclusion

This paper is the first to examine peer effects in female bargaining power and child food intake, using primary data on self-reported networks in rural north India. We use a community-level women’s empowerment program, *Mahila Samakhya*, to identify shocks to female bargaining power. Using a 3SLS approach and network-weighted instrumental variables, we find that participation in the community-level intervention empowers participant, and that women with more participant friends have a greater say in their household decision making as well as better-fed children. Our estimates of causal peer effects relax two restrictive assumptions commonly made in the literature: (1) we relax the assumption of separability group formation and information flows by instrumenting for networks, and (2) we address the reflection problem without assuming that social networks are directed. We are able to do so by examining the impact of friends’ participation on non-participants’ intrahousehold bargaining power and children’s food intake. We further hypothesize that peer effects in household decision making work through the potential channels of information, influence, identity utility, and social norms. We then provide suggestive evidence that information and influence have different effects on bargaining power (physical mobility, access to outside employment, and working outside the household) than on child food intake.

Extensions of this work include controlling for spatial error as well as heteroscedasticity; spatial error in this context would suggest that individual i 's shock are most closely correlated with i 's friend's shocks and that this autocorrelation decays over network distance. We also intend to further exploit the data on types of networks (relatives versus friends), strength of ties (frequency of interactions), and the directionality of ties in the vein of Card and Giuliano (2011) to better understand how influence and identity affect the household bargain. In particular, we want to understand how restrictive the directed network ties assumption is by using variation in reciprocity in naming friends.

This analysis is, of course, not without caveats. The paper would benefit from panel data tracking women and their peer networks. Ideally, we would be able to randomize an intervention such as a literacy

camp or support group participation at the friend level, and follow their effect on individuals across time. Further, the limited snowball sampling strategy employed in data collection means that the results are not representative of the average Indian woman, or even the average Uttarakhandi. Generalizations of these results must therefore involve caution. We are also unable to extrapolate past bargaining power and child food intake to welfare in general. In particular, there are unclear impact on the extensive if, for instance, girls receive more food but are made to spend less time on homework and more on household chores. Policy implications from this analysis must therefore involve caution since we only consider one part of a much larger picture.

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9 Figures and Tables

Figure 1: Uttarakhand

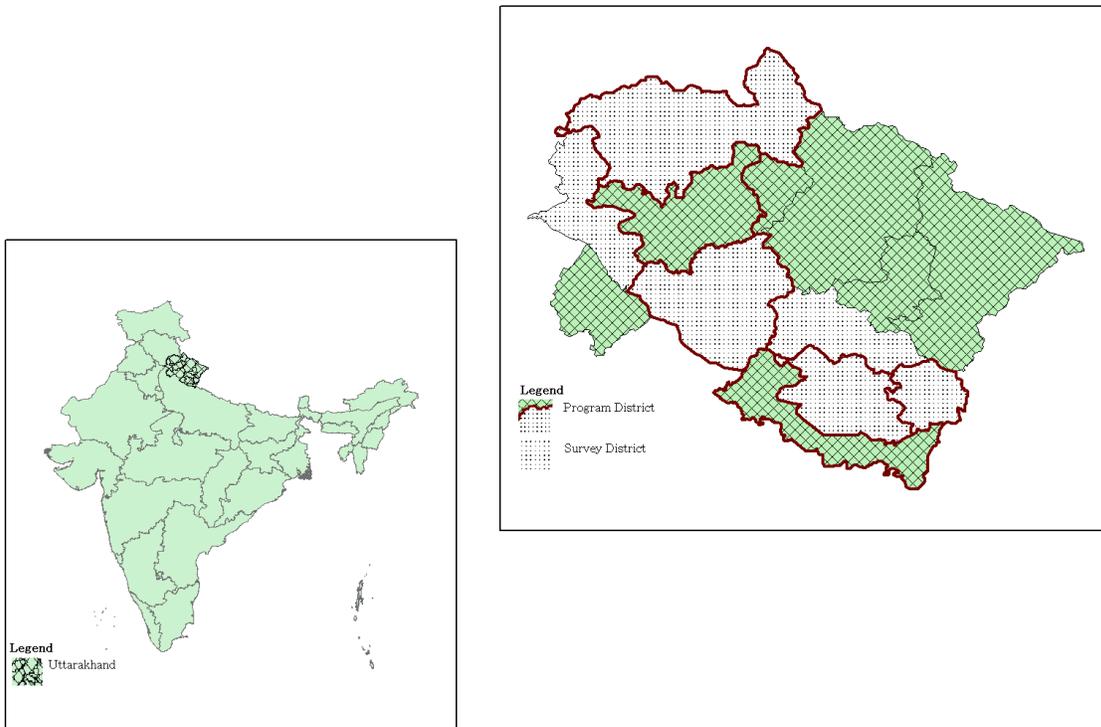


Figure 2: Inefficiencies Can Constrain and Lower the Household Production Possibilities Frontier

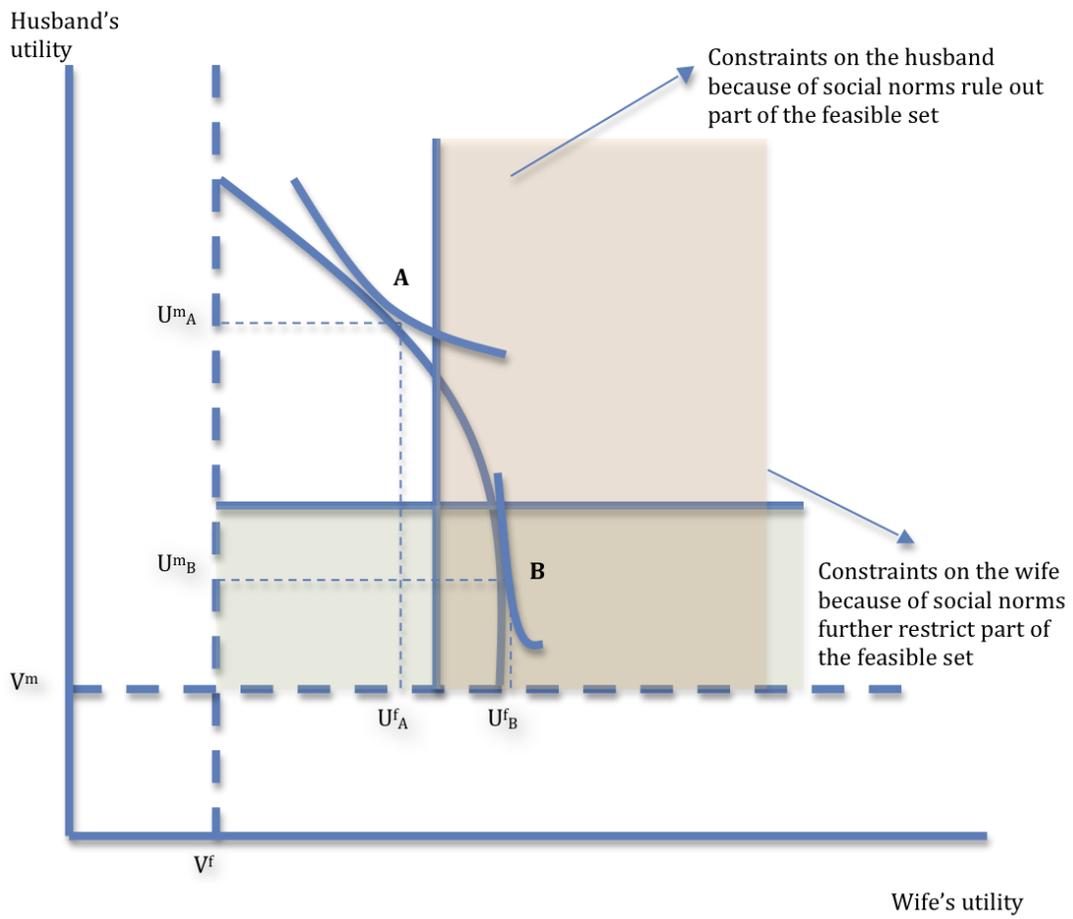


Figure 3: Inefficiencies Can Constrain and Lower the Household Production Possibilities Frontier

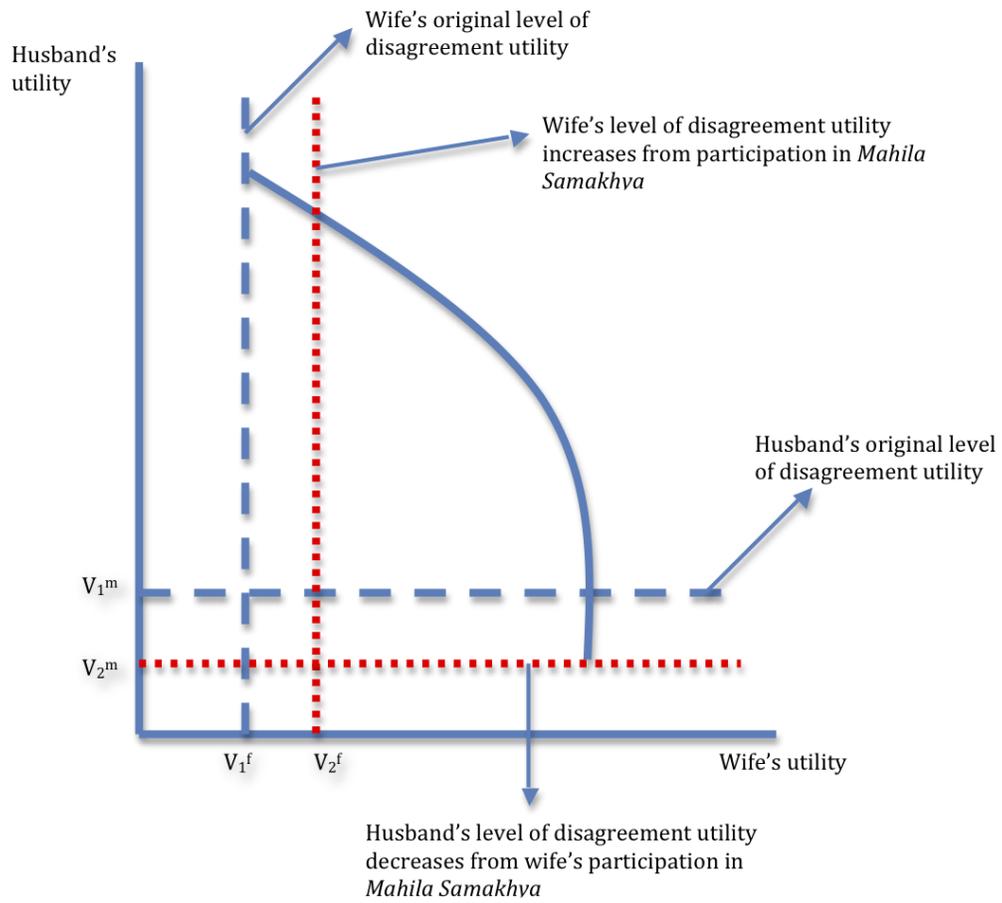


Figure 4: Inefficiencies Can Constrain and Lower the Household Production Possibilities Frontier

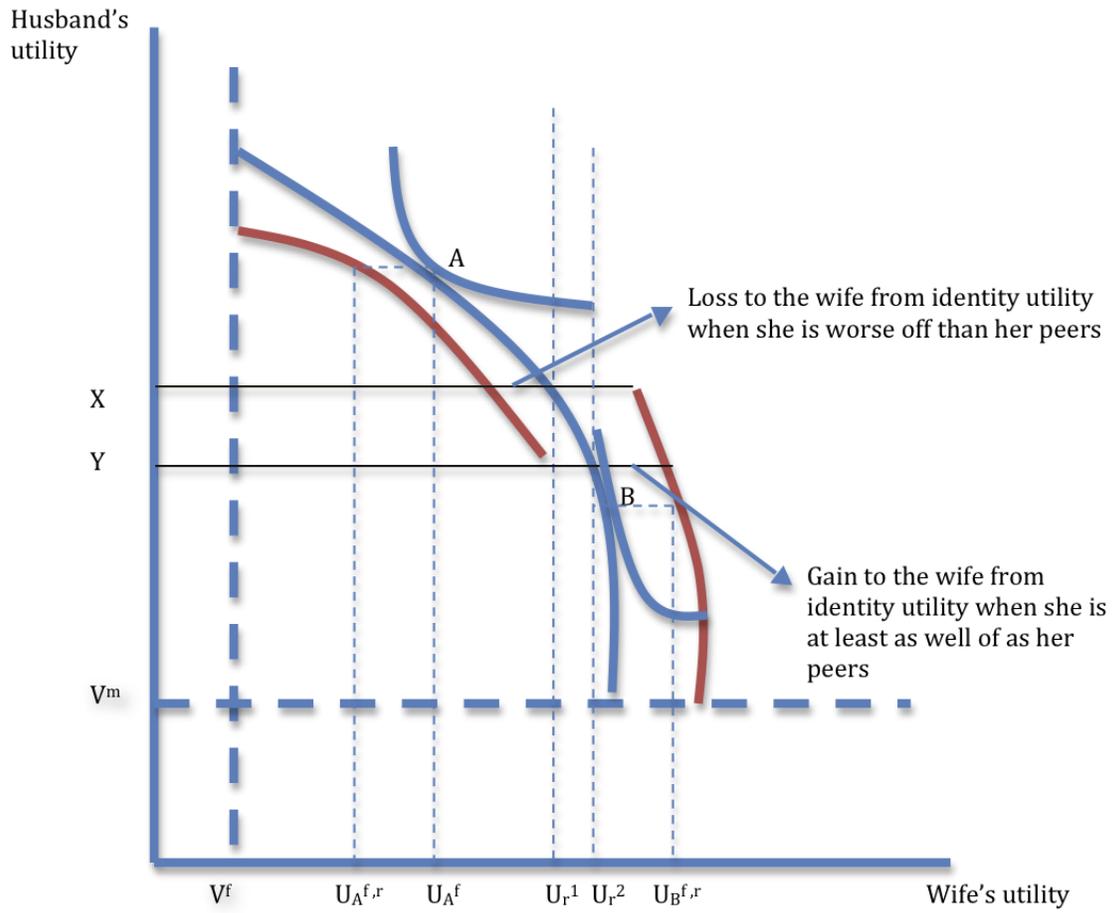


Figure 5: Network Sizes: Top Code of Five Doesn't Appear to be a Binding Constraint

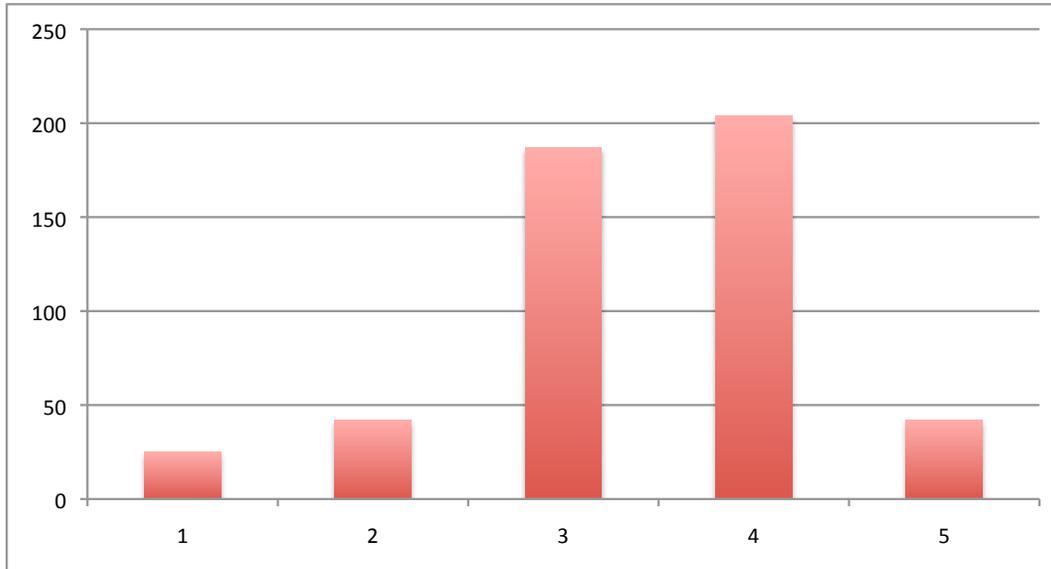


Figure 6: Coefficient Estimates of Friends' Participation on Non-Participants' Likelihood of Working Outside Household Over Network Size

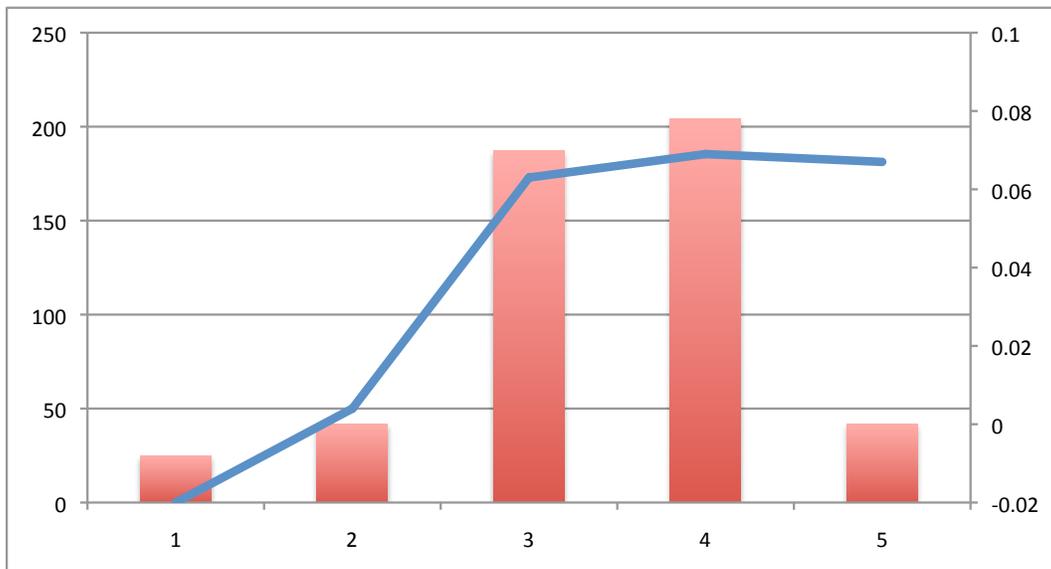


Table 1: Summary Statistics Using a Women’s Empowerment Study, Uttarakhand, India, 2009-2010

Variables	Mean	Std. Dev	Min	Max	Observations
Respondent’s Age	32.13	8.11	20	65	447
Husband’s Age	37.76	9.25	23	80	414
Wife’s Age-Husband’s Age	-5.56	3.90	-29	5	414
Less than Primary Education	0.23	0.42	0	1	459
Respondent’s Years of Education	7.56	4.93	0	17	459
Average Age of Sons	7.90	7.67	0	36	487
Average Age of Daughters	6.22	6.69	0	30	487
Number of Sons	1.22	0.89	0	5	487
Number of Daughters	1.07	1.02	0	5	487
Brahmin	0.19	0.39	0	1	487
Asset Index† Quintiles	2.99	1.42	1	5	438

† Filmer & Pritchett [2001].

Table 2: Balance Between *Mahila Samakhya* Participants and Non-Participants

Variables	Non-participants	Participants	Difference	t-test	Observations
Age	30.67	33.06	-2.40	-2.61	447
Husband’s Age	37.00	38.22	-1.21	-1.08	414
Spousal Age Difference	-6.02	-5.28	-0.74	-2.03	414
Less than Primary Educ.	0.19	0.26	-0.07	-1.48	459
Respondent’s Years of Education	8.12	7.19	0.94	1.38	459
Average Age of Sons	7.26	8.97	-1.71	-1.81	487
Average Age of Daughters	6.33	6.54	-0.21	-0.25	487
Number of Sons	1.16	1.37	-0.21	-1.76	487
Number of Daughters	0.98	1.14	-0.16	-1.31	487
Brahmin	0.05	0.21	-0.16	-3.16	487
Asset Index† Quintiles	3.15	2.89	0.27	1.42	438

† Filmer & Pritchett [2001].

Table 3: Female Bargaining Power: Dependent Variables from a Women’s Empowerment Study, Uttarakhand, India, 2009-2010

	Works Outside HH	Has NREGS Card	Doesn’t Need Permission
Non-participants	0.52	0.49	0.57
Participants	0.50	0.67	0.79
Difference	0.02	-0.17	-0.22
t-stat	0.19	-2.06	-2.55
Observations	424	487	487

Table 4: Child Food Intake in Past Day: Dependent Variables Using a Women’s Empowerment Study, Uttarakhand, India, 2009-2010

	Rice Consumption	Dal Consumption
Non-participants	2.45	2.10
Participants	2.30	2.31
Difference	0.149	-0.21
t-stat	0.49	-0.92
Observations	803	803

Table 5: First Stage Regression: Own Program Participation

	Own Participation
Exposure to Program	0.016*** (0.004)
Friends' Participation	-0.001 (0.007)
Spousal Age Difference	-0.014** (0.006)
Own_age	0.008** (0.003)
Less than Primary Education	0.049 (0.058)
Years of Education	-0.006 (0.004)
Number of Sons	0.009 (0.026)
Age of Sons	0.000 (0.003)
Brahmin	0.261*** (0.056)
Lives with In-laws	-0.102** (0.048)
Asset Index	-0.051* (0.029)
Constant	0.669*** (0.127)
Observations	404
Wooldridges test for overid	0.17
p-value for Wooldridge's [1995] test for overid	0.68
F-test for strength of instrument	11.89
Robust regression test for endog.	50.15
p-value for Robust regression test for endog.	0.00

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Robust standard errors; specification includes network fixed effects.

Table 6: First Stage Regression: Group Formation and Friends' Participation

	Reported Friends' Participation
Participation IV*Same Caste	0.032*** (0.002)
Participation IV*Similar Water Collection Time	0.007*** (0.000)
Number of Observations	404
Wooldridges test for overid	1.83
p-value for Wooldridge's [1995] test for overid	0.18
F-test for strength of instrument	43.67
Robust regression test for endog.	6.08
p-value for Robust regression test for endog.	0.01

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Robust standard errors; specification includes network fixed effects.

Table 7: Female Bargaining Power: Base 3SLS Regressions

	Works Outside Household	NREGS Card	Doesn't Need Permission
Own Participation	1.470** (0.686)	1.430*** (0.287)	0.375* (0.219)
Friends' Participation	0.075*** (0.027)	-0.116*** (0.037)	0.057* (0.030)
Own*Friends' Participation	-0.066 (0.047)	0.140** (0.058)	0.084* (0.049)
Low Education	0.059 (0.07)	-0.029 (0.090)	0.107 (0.065)
Years of Education	0.039** (0.012)	-0.006 (0.090)	0.008 (0.008)
Spousal Age Difference	-0.002 (0.008)	-0.019* (0.010)	-0.004 (0.007)
Own Age	0.001 (0.004)	-0.004 (0.005)	-0.005 (0.004)
Number of Children	-0.084 (0.068)	-0.004 (0.057)	-0.008 (0.048)
Age of Children	-0.003 (0.005)	0.008 (0.007)	0.004 (0.005)
Lives with In-laws	0.047 (0.061)	0.164** (0.075)	-0.017 (0.056)
Brahmin	0.107 (0.104)	-0.553*** (0.119)	-0.035 (0.088)
Asset Index	0.001 (0.035)	0.066 (0.048)	0.045 (0.035)
Constant	-0.839* (0.444)	-0.370 (0.249)	0.546*** (0.191)
Number of Observations	404	404	404

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Robust standard errors; all specifications includes network fixed effects.

Table 8: Female Bargaining Power: Marginal Effects

	Works Outside HH	NREGS Card	Doesn't Need Permission
Effect of Own Participation on Average Respondent	1.264 (0.79)	1.903*** (0.44)	0.090 (0.35)
Effect of Friends' Participation on Average Respondent	0.032** (0.02)	-0.029** (0.01)	0.005 (0.01)
Effect of Friends' Participation on Participants	0.007 (0.03)	0.024 (0.03)	-0.027 (0.02)
Effect of Friends' Participation on Non-participants	0.072** (0.03)	-0.116*** (0.04)	0.057* (0.03)

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Robust standard errors; all specifications includes network fixed effects.

487 women; 299 participants, 188 non-participants.

Table 9: Children's Food Consumption: 3SLS Regressions

	Rice	Dal
Own Participation	1.349*** (0.296)	1.113*** (0.248)
Friends' Participation	-0.016 (0.040)	-0.107*** (0.040)
Own*Friends' Participation	0.104 (0.080)	0.187** (0.079)
Wife's Food Consumption	-0.004 (0.025)	0.006 (0.019)
Husband's Food Consumption	0.058*** (0.018)	-0.008 (0.026)
Brahmin	-0.676*** (0.170)	-0.610*** (0.145)
Lives with In-laws	- 0.014 (0.099)	0.290*** (0.094)
Wife's Age-Husband's Age	0.023* (0.013)	-0.012 (0.013)
Mother's Age	0.055*** (0.008)	0.054*** (0.007)
Number of Other Children	-0.246*** (0.074)	-0.070 (0.070)
Child's Age	0.002 (0.003)	0.007** (0.003)
Child's Sex	-0.103 (0.085)	-0.159* (0.082)
Asset Index	0.153** (0.069)	0.043 (0.065)
Constant	-0.256* (0.339)	-0.744*** (0.327)
Observations	803	803

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Robust standard errors; all specifications includes network fixed effects.

Table 10: Children’s Food Intake: Marginal Effects

	Rice Consumption	Dal Consumption
Effect of Own Participation on Average Respondent	0.998** (0.496)	1.74*** (0.455)
Effect of Friends’ Participation on Average Respondent	0.079 (0.021)	0.008** (0.019)
Effect of Friends’ Participation on Participants	0.119*** (0.047)	-0.079* (0.040)
Effect Friends’ Participation on Non-participants	-0.016 (0.040)	0.107** (0.040)

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Robust standard errors; all specifications includes network fixed effects.
803 children born to 299 participants and 188 non-participants.

Table 11: Household Fixed Effects Show Significant Gender Differences in Child Food Intake

	Child Rice Consumption	Child Dal Consumption
Own Participation*Female	-0.113 (0.209)	-0.093 (0.176)
Friends’ Participation*Female	-0.196 (0.028)	0.053** (0.024)
Female	-0.140 (0.174)	-0.119 (0.146)
Number of Observations	531	531

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Robust standard errors; includes network fixed effects.

This sample consists of 401 boys and 402 girls.

Table 12: Summary of Mechanism Identification Strategy

Mechanism	Proxy	Interactions
Social Learning	Less than four years of education	Own Part.; Friends' Part.
Social Influence	Spousal Age Ratio	Own Participation
Identity Utility	Friends' Opinion (Women)	Own Part.; Friends' Part.
Norms	Villagers' Opinion (Men)	Own Part.; Friends' Part.

Table 13: Expected Signs on on Key Independent Variables

Independent Variable	Learning	Influence	Identity Utility	Norms	Expected Sign
Low Education	Yes	No	No	No	Negative
Low Educ.* Own Part.	Yes	No	No	No	Positive
Low Educ.* Friends' Part.	Yes	No	No	No	Positive
Spousal Age Ratio	No	Yes	No	No	Negative
Age Ratio* Own Part.	No	Yes	No	No	Positive
Friends' Opinion (Women)	No	No	Yes	No	Positive
Friends' Opinion*Own Part.	No	No	Yes	No	Positive
Friends' Opinion*Friends' Part.	No	No	Yes	No	Positive
Villagers' Opinion (Men)	No	No	No	Yes	Negative
Villagers' Opinion*Own Part.	No	No	No	Yes	Negative
Villagers' Opinion*Friends' Part.	No	No	No	Yes	Positive

Table 14: Female Bargaining Power: Marginal Effects Using a Women's Empowerment Study, Uttarakhand, India, 2009-2010

	Outside Work	NREGS	Permission
<i>Social Learning</i>			
Effect of Own Participation on Women with Low Education	0.846 (0.89)	1.729 (0.39)	0.146 (0.22)
Effect of Friends' Participation on Women with Low Education	0.183** (0.08)	-0.089** (0.04)	0.049* (0.02)
Effect of Friends' Participation on Non-participants with Low Education	0.063* (0.03)	-0.091** (0.04)	0.05* (0.03)
<i>Social Influence</i>			
Effect of Own Participation on Average Respondent (Spouses' Ages)	1.322* (0.69)	1.438** (0.27)	0.351* (0.16)
Effect of Friends' Participation on Non-participant (Spouses' Ages)	0.051 (0.04)	0.056 (0.04)	-0.036 (0.03)
<i>Identity Utility</i>			
Effect of Own Participation on Friends' Opinion (Average Respondent)	0.541* (0.29)	1.612*** (0.31)	0.418* (0.23)
Effect of Friends' Participation on Friends' Opinion (Average Respondent)	0.027 (0.04)	-0.099** (0.04)	0.032 (0.03)
Effect of Friends' Participation on Friends' Opinion (Participants)	0.027	-0.01***	0.031**

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Table 14 – Continued

	Outside Work	NREGS	Permission
	(0.04)	(0.003)	(0.03)
Effect of Friends' Participation on Friends' Opinion (Non-participant)	0.027	-0.099***	0.032**
	(0.04)	(0.04)	(0.03)

Standard errors statistics in parentheses.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Opinion 1: importance of friends' opinion to woman.

Opinion 2: importance of villagers' opinion to husband

Table 15: Children's Food Intake: Marginal Effects Using a Women's Empowerment Study, Uttarakhand, India, 2009-2010

	Rice	Dal
<i>Social Learning</i>		
Effect of Own Participation on Women with Low Education	0.953** (0.329)	0.953** (0.270)
Effect of Friends' Participation on Women with Low Education	-0.051 (0.052)	-0.123 (0.051)
Friends' Participation on Participants with Low Educ.	-0.051 (0.053)	-0.123** (0.052)
Friends' Participation on Non-participants with Low Educ.	-0.053 (0.050)	-0.1220 ** (0.049)
<i>Social Influence</i>		
Effect of Own Participation on Average Respondents (Age Diff.)	0.806** (0.319)	0.662** (0.276)
<i>Identity Utility</i>		
Effect of Own Participation on Friends' Opinion (Avg. Resp.)	1.485*** (0.326)	1.373*** (0.284)
Effect of Friends' Participation on Friends' Opinion (Avg. Resp.))	0.043 (0.051)	-0.049 (0.049)
Effect of Friends' Participation on Friends' Opinion (Participants)	0.044 (0.051)	-0.049 (0.050)

Table 15 – Continued

	Rice	Dal
Effect of Friends' Participation on Friends' Opinion (Non-participants)	0.042 (0.049)	-0.052 (0.049)
<i>Norms</i>		
Effect of Own Participation on Villagers' Opinion (Avg. Resp.'s husband)	0.688** (0.297)	0.928*** (0.264)
Effect of Friends' Participation on Villagers' Opinion (Avg. Resp.'s husband)	-0.045 (0.044)	-0.044 (0.044)
Effect of Friends' Participation on Villagers' Opinion (Participants' husbands)	-0.045 (0.044)	-0.044 (0.043)
Effect of Friends' Participation on Villagers' Op. (Non-part.'s husbands)	-0.0459 (0.044)	-0.0438 (0.044)

Standard errors statistics in parentheses.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Opinion 1: importance of friends' opinion to woman.

Opinion 2: importance of villagers' opinion to husband