Measuring Social Networks' Effects on Agricultural Technology Adoption

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Why incomplete or slow adoption of new agricultural technologies?

- Earlier literature: price and individual characteristics (Feder et al. 1985; Griliches 1957, Rogers 1995)
- Importance of social networks in recent literature (Foster and Rosenzweig 1995)
- Identifying social interaction effects in the data is challenging
  - Correctly identify and measure social networks
  - Separate social interaction effects from correlated effects
  - Solve the simultaneity problem

Policy questions

- Funds for agricultural extension are declining: how does one make use of the existing funds in the most effective manner?
- Which farmers, if any, does one target with information anticipating crowding out?
- Which farmers, if any, does one target with subsidies?

Overview talk

- Review literature (focusing on measurement of information networks)
- Illustrate using detailed information network data from India
- Valuation/WTP of Lybbert, Magnan, Bhargava, Gulati and Spielman might depend on information or other networks
- Trait-based learning of Useche, Barham and Foltz implies more complex multi-dimensional learning

Theoretical considerations

- What do farmers value and over which time period?
- What type of information do farmers learn about?
- How do farmers learn?
- How do farmers interact?

The context and model determines the type of network and other data to be collected

Measuring social networks (1)

- Equate social networks to group identity (Foster and Rosenzweig 1995, Munshi 2004)
  - Misrepresent the social network
  - Network might coincide with geographic/climatic characteristics
- Use a village census and ask all villagers about all of their information contacts (Van der Broeck and Dercon 2011, Kremer and Suri ongoing)
  - Feasible in small closed village context where one can ask 'closed' questions about information contacts –> the 'ideal' method

Measuring social networks (2)

- Snowball sampling (Scott 1991)
  - Non-representative sample
- Network within sample (Santos and Barrett 2008, Chandrasekhar and Lewis 2011)
  - Truncates the network
- Network of the sample (Bandiera and Rasul 2006)
  - ‘open’ versus ‘closed’ questions (‘strong’ versus ‘weak’ links; Granovetter 1973)
  - Truncates the network
- Random matching within sample (Conley and Udry 2010, Santos and Barrett 2008, McNiven and Gilligan 2011)
  - Star-shaped structures

Our study

Social networks in 3 villages in India

Data collected (1)

- 2007-2008: re-survey 246 ICRISAT-VLS respondents in Aurepalle, Kanzara and Kinkhed
- Cotton is main cash crop and currently 64% cultivate Bacillus thurigiensis (Bt) cotton
- Set of progressive farmers (total=43) identified at the start of the study
  - Central role in dispersion of information
- Household composition (education, age), landholding (soil characteristics), risk preferences, income and wealth

Data collected (2)

- Network of the sample through 'open' questions (limit of 5)
- Network of the sample of progressive farmers through 'closed' questions
- Random matching within sample
  - Each respondent is matched up with six randomly drawn respondents and four fixed progressive farmers.
  - A set of questions on the relationship between the respondent and X and the respondent's knowledge about X's farming activities
  - 'Who would you go to for advice in case of problems with your cotton crop?'

–> 25% of contacts mentioned in random matching within sample also mentioned in open question –> forgetting of 'weak' links is a real problem

Descriptive statistics

Introducing the three villages

	Aurepalle	Kanzara	Kinkhed
Number of households in village	925	319	189
Number of households in sample	128	63	55
Median rainfall (mm/year)[1]	434	748	745
Distance to nearest town (km)	10	9	12
Average education level of respondent (in years)	2.31	6.61	6.89
Average number of household members	4.23	4.87	4.5
Average yearly income (Rs)[2]	43,543	53,720	38,087

Notes: [1]2001-2007; [2]2004-2005

Descriptive statistics

From the random matching within sample

	Aurepalle	Kanzara	Kinkhed
1. Know X? (%)	87.8	99.2	100
2. Does X farm? (% of 1)	82.3	83.7	91.6
3. Does X farm cotton? (% of 2)	57.2	70.2	90
4. Know X's yield? (% of 3)	30.2	39.1	68.6
5. Know X's pesticide use? (% of 3)	29.5	31.1	75.9
6. Know X's cultivar? (% of 3)	69.3	85.8	75.4
7. Know X's yield, pesticide use and cultivar? (% of 3)	21.9	27.8	63.6
8. X's yield correct (% of 4)	31.4	21.2	16.3
9. X's pest correct? (% of 5)	14.6	25.1	61.1
10. X's cultivar correct? (% of 6)	86	81.9	77.3
11. X's yield, pesticide use and cultivar correct (% of 7)	7.4	5.7	12.4

Note: In (4), (5), (6) and (7) "knowing" means that the respondent was able to name the cultivar, the amount of pesticides used, the yield per acre obtained etc. of match X. Knowledge of yield and pesticide use was considered correct if the perceived value was within a 10% range of the actual value. If X cultivated multiple cultivars, the perceived value of the average yield of Bt and non-Bt was compared with the actual average. In case of pesticide use the discrete decision was often known (whether X uses pesticides or not) but not the exact number of sprays. In this case, knowledge was considered incorrect.

Incomplete knowledge and asymetric relationships (1)

- Farmers learn from company agents to the village, government extension agents and input dealers
  - Respondents heard from 0.9 outside sources in the last seven years about Bt cotton, and found this information 'useful' to 'very useful' in 75% of the cases
- Relationships are asymetric
  - In 45% of the matches with progressive farmers, the progressive farmers states he never speaks to the respondent, while the respondent claims they do speak on a regular basis

Incomplete knowledge and asymetric relationships (2)

- Farmers are not aware of each others' networks
  - In 20% of the matches the respondent incorrectly assumes that the knowledge relationship (with regard to yield and pesticide use) is symmetric
  - In 15% of the matches the respondent states that he does not know whether or not the match is aware of their (the respondent's) yield and pesticide use
- Define a learning link to be present if the respondent thinks he knows the cultivar choice, yield outcome and pesticide use of the match X.

Correlates of social network

Location and social group (caste) matters

Probit regression with dependent variable: presence of a "learning link" between respondent and match

	Pooled	
	dF/dX	Error
Relative risk preferences	0.029	(0.021)
Similar soil conditions	0.064*	(0.038)
Live in same neighborhood	0.150***	(0.052)
Pass by X's field when going to field	0.028	(0.055)
X's field close to respondent's field	0.184***	(0.056)
Belong to same sub-caste (*jati*)	0.186***	(0.050)
Education of HH head (sum)	0.006	(0.004)
Education of HH head (diff)	-0.004	(0.004)
Income (10,000 Rs) (sum)	-0.004**	(0.002)
Income (diff)	0.001	(0.002)
Land (acres) (sum)	0.002	(0.002)
Land (acres) (diff)	-0.002	(0.002)
Land value (10,000 Rs/acres) (sum)	0.000	(0.001)
Land value (diff)	-0.002	(0.003)

Notes: *** p<0.01; ** p<0.05; * p<0.1; Controls for whether or not respondents and match have the same family name and are member of the same (farmers', credit, etc.) organization, sum and difference of number of household members, number of adults, value of machinery, age of household head, and irrigation status. Total number of observations = 1096.

Correlates of social network

Similarity in soil conditions and risk attitudes matter

Probit regression with dependent variable: presence of a "learning link" between respondent and match

Village:	Aurepalle		Kanzara		Kinkhed	
	dF/dX	Error	dF/dX	Error	dF/dX	Error
Relative risk preferences	0.107***	(0.039)	0.111***	(0.034)	-0.092**	(0.039)
Similar soil conditions	0.146***	(0.056)	0.005	(0.063)	0.027	(0.063)
Live in same neighborhood	0.178**	(0.087)	0.075	(0.113)	0.167**	(0.060)
Pass by X's field when going to field	0.130*	(0.074)	-0.013	(0.100)	-0.272**	(0.146)
X's field close to respondent's field	0.199**	(0.099)	0.334**	(0.141)	0.163**	(0.070)
Belong to same sub-caste (*jati*)	0.216***	(0.083)	0.178**	(0.084)	0.161*	(0.070)
Education of HH head (sum)	0.026***	(0.007)	-0.004	(0.011)	0.003	(0.008)
Education of HH head (diff)	-0.015**	(0.007)	0.027**	(0.011)	0.005	(0.008)
Income (10,000 Rs) (sum)	0.017***	(0.005)	-0.006**	(0.003)	0000	(0.005)
Income (diff)	0.015***	(0.005)	-0.005	(0.003)	0.002	(0.005)
Land (acres) (sum)	0.000	(0.006)	0.008**	(0.005)	-0.004	(0.003)
Land (acres) (diff)	-0.014**	(0.007)	-0.016***	(0.005)	0.000	(0.004)
Land value (10,000 Rs/acres) (sum)	0.002	(0.002)	0.001	(0.005)	0.018**	(0.008)
Land value (diff)	-0.005*	(0.003)	-0.029**	(0.013)	-0.001	(0.020)

Notes: *** $p<0.01$; ** $p<0.05$; * $p<0.1$; Controls for whether or not respondents and match have the same family name and are member of the same (farmers', credit, etc.) organization, sum and difference of number of household members, number of adults, value of machinery, age of household head, and irrigation status. Total number of observations = 1096.

Future research

- Pay attention to the manner in which a social network measure is obtained (what is the relevant network? sample? framing of questions)
- Accompany with data on ‘correlated effects’ (GPS, soil and climatic conditions, behavioral experiments to elicit preferences with regard to risk and time, information from non-farmer sources)
- As technology adoption is a dynamic process, cross-sectional estimates of current adoption status might be biased −> panel or quasi-panel data (paying attention to what can reasonably be recalled), including panel data on information networks
- Collect data on beliefs regarding prices and new technologies
- Use these data to test various models of technology adoption and updating of beliefs against one another:
  - How is information processed, shared and does it change the information networks themselves?
  - Social pressures, networks in water management, labor networks, credit and insurance networks might play a role as well