Participatory Approach to Community Based Water Supply System

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Outline

- Research Background & Objective
- Spatial Probit Model
  - Model formulation
  - Model estimation
- Case Study
- Conclusion & Future Perspectives

Background

- Lack of access to clean water due to improper water institution
- There exists a kind of collaborative action on community based water supply system
- Necessitate of better understanding about local community structure and network
- Objective:
  - To investigate interdependent preference in a choice of clean water of the community on a field survey of Indonesian's water supply system

Spatial Probit Model

- Discrete-choice model for whether an household joins HIPPAM conditional on that household's characteristics

$$z = X\beta + \theta + \varepsilon \quad \varepsilon \sim N(0, I_n)$$

$$\theta = \rho W\theta + u \quad u \sim N(0, \sigma^2 I_n)$$

$$y_i = \begin{cases} 1 \text{ when household } i \text{ belongs to HIPPAM} & z > 0 \\ 0 \text{ when household } i \text{ does not belong to HIPPAM} & z \le 0 \end{cases}$$

  - θ : spatial interaction term
  - X : households' attribute
  - ρ: degree of spatial dependence across households
  - W : spatial weight matrix about households' network

Model Estimation

- It is difficult to estimate spatial probit model by maximum likelihood since this model has complicated form
- Then, we use the Bayesian inference approach to estimate each parameters of equation by using the Markov Chain Monte Carlo (MCMC) method
- MCMC algorithm arrives at the target distribution of the unknown parameters by sequentially sampling from a set of conditional distributions of the parameters.

$$\text{Bayes theorem} \quad \mathrm{p}(\theta \mid \mathrm{y}) \propto L(y \mid \theta) \cdot \pi(\theta)$$

$$\mathrm{p}(\cdot) : \text{posterior distributi on}$$

$$\mathrm{L}(\cdot) : \text{likelihood function}$$

$$\pi(\cdot) : \text{prior distributi on}$$

Case Study

- Field survey: December 2008
- 500 households living at Toyomarto village (TY) and Candi Renggo village (CR), Singosari district, East Java province
- The respondents are the husband, the wife or the head of family
- There exists two public water providers, HIPPAM (community based water supply system) and PDAM (Indonesia local water company)
- The dependent variable was defined as following:

$$y_i = \begin{cases} 1 \text{ when household } i \text{ belongs to HIPPAM} & z > 0 \\ 0 \text{ when household } i \text{ belongs to PDAM} & z \le 0 \end{cases}$$

Explanatory Variables

- *FAM*: number of people in household
- *GENDER*: dummy variable which equals 1 if respondent is male
- *AGE*: age of respondent
- *EDU*: dummy variable which is recorded as 1 if respondent has educational background in the level of elementary school or junior school and recorded as 0 if high school or university.
- *OCCU*: dummy variable which is coded as 1 if occupation of respondent is Agricuture or manufacturing and coded as 0 if service or unemployment
- *INCOME*: household's monthly income which is divided into 7 items (less than 0.5, 0.5-1.0, 1.0-1.5, 1.5-2.0, 2.0-2.5, 2.5-3.0, more than 3.0 million Rupiah), and we use the medians of each item.
- *LENGTH*: years of living in the area for respondent
- *COST*: water charge per day (Rupiah)

Weight Matrix

- Hypothesis: households with stronger community tie have ability to organize community based on management system
- Therefore, we define a spatial weight matrix using the data about community networks

$$w_{ij}^{gk} = \begin{cases} 1 & \text{if household i and household j join the same social group k} \\ 0 & \text{otherwise} \end{cases}$$

$$w_{ij} = \sum_{k=1}^{4} w_{ij}^{gk}$$

	1.Religious	2.Cultural /Social	3.Community organization	4.Finance
TY	138	28	14	15
CR	87	36	41	13

Estimation Results (TY)

	Spatial Probit Model				
Variable	p.Mean	p.Std.Dev	90% Credible Interval		Geweke
constant	3.620	1.545	1.212	6.200	1.872
FAM	−0.085	0.204	−0.415	0.246	0.603
GENDER	0.035	0.509	−0.801	0.861	0.607
AGE	−0.031	0.023	−0.069	0.006	1.680
EDU	−0.136	0.579	−1.112	0.788	0.322
OCCU	−0.234	0.485	−1.062	0.561	2.863
INCOME	0.228	0.367	−0.364	0.844	0.499
LENGTH	0.026	0.014	0.003	0.049	1.949
COST	−0.004	0.001	−0.005	−0.003	2.224
σ^2	0.128	0.027	0.092	0.177	1.220
ρ	−9.016	5.486	−17.345	0.175	1.203

Conclusion

- In this paper, we show the spatial probit model with using Bayesian estimation method in order to investigate resident's spontaneous collaboration to manage community based water supply system

- From the estimation results, we can say that the length of living in the area and the price of monthly water usage have an important meaning for respondent to make a decision to join community based water supply system.

- Future perspectives:
  - Another approach to get weight matrix through geographical neighbors
  - Social Network Analysis

Thank you for your attention