Peer Effects in Agricultural Extension: Evidence of Endogenous Social Interaction in the Performance of Community Knowledge Workers (CKWs) in Uganda

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Goal
This research aims to identify and estimate peer effects in the performance of rural extension workers.

Performance is measured by their monthly output as captured by the monthly target records obtained over a period of thirteen months (December 2010–December 2011).

Background
The CKW program, which started as a pilot project in Uganda in 2010 by Grameen Foundation, provides agricultural information to rural farmers by a select group of local farmers within their communities to perform the role of community extension agents.

They use programmed cellphones (Android) which contains an agricultural information database that provides answers to farmers’ questions and concerns. The process is called of checking for answers in the database is called search.

Grameen Foundation hopes to mainstream the innovation across the developing world.

CKWs work under the supervision of Grameen APLAB (Application Lab) which works on new innovations.

One of the major impacts of the program is the high level of information provided by these CKWs to rural farmers who are often marginalized by traditional extension workers.

Data
We utilize a unique dataset of cellphone records of CKW-activities in rural Uganda on a monthly basis. Data includes geographic coordinates of CKW (i.e., geocodes), number of times an accurate information (search or query) is submitted by a CKW on farmers’ behalf, and other socioeconomic characteristics such as age, gender and the number of training they have attended.

Approach
- Since there is a wide consensus that it is difficult to effectively measure and disentangle the direct impact of extension on farm productivity due to a lack of precise attribution to extension;

- We use the monthly performance of individual CKWs as proxy for the productivity of extension workers in Uganda through peer effects estimates of their individual performance.

- We hope that such estimates can be generalized to provide a good measure of extension performance in developing countries and elsewhere.

- We use the linear-in-means model in which the outcome of individuals in a group is expressed (linearly) in terms of own characteristics, the average (means) outcomes of the group and the mean characteristics of the individual, to estimate peer effects among CKWs in Uganda.

- We instrument for the endogeneity of peer outcomes by using the lags of the peers of peers, using a K-nearest neighbor of 5 peers. This obtains from advances in social network analysis.

- Further, we construct a K-Nearest neighbor/peer interaction matrix based on the 5 nearest neighbors of each CKW. It is based on partially overlapping and Non-symmetric neighbors.

- We use spatial two-staged least square regression to analyse the effects of CKWs on the performance of their peers.

Econometric Model
The model is:

\[ y_{it} = \beta_0 + \beta_1 x_{it} + \beta_2 x_{jt} + \beta_3 x_{it} x_{jt} + \epsilon_{it} \]

Where \( x_{it} \) and \( x_{jt} \) are the same vector of monthly performance as shown by the valid respondents CKWs.

\[ \epsilon_{it} = \delta_t + \omega_{it} + \lambda_t \]

Where \( \delta_t \) and \( \omega_{it} \) are random effects and the exogenous effect. We assume that \( (0 < \delta_t < 1) \).

The errors generated in the general network \( X, Y, X, \ldots \) are i.i.d.

We have no correlated effects.

In matrix terms, we have:

\[ \mathbf{S} = \mathbf{D} \times \mathbf{W} \times \mathbf{D} + \mathbf{N} \]

Where \( \mathbf{D} \) is a diagonal matrix with \( (1, 1, \ldots) \) and \( \mathbf{N} \) is the matrix of explanatory variables; and \( \mathbf{W} \) is the weight matrix.

For stage 1,

\[ \mathbf{S} = (\mathbf{I} - \mathbf{W}) \mathbf{Z} = (\mathbf{I} - \mathbf{W}) \mathbf{Z} = (\mathbf{I} - \mathbf{W}) \mathbf{W} \mathbf{Z} \]

for \( \mathbf{Z} = (1, 0, 0, \ldots) \).

Similarly, we have:

\[ \mathbf{S} = (\mathbf{I} - \mathbf{W}) \mathbf{Z} = (\mathbf{I} - \mathbf{W}) \mathbf{Z} = (\mathbf{I} - \mathbf{W}) \mathbf{W} \mathbf{Z} \]

for \( \mathbf{Z} = (1, 0, 0, \ldots) \).

On average, CKWs perform 45 valid searches per month. 45% of them own bicycles on their own. The average age is 36 with 71% being married. Moreover, 45% work across hilly terrains.

Conclusion
This research is first to identify the existence of peer effects among extension workers in terms of their performance.

Our results have vital policy implication for stimulating agricultural development. It provides a means by which the productivity of extension can be measured on a component-by-component basis. For example, through peer effects in the performance of extension workers, it is possible to allocate resources more efficiently by arranging better teams of workers in the sector.

Key References