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Signals, Similarity and Seeds: Social Learning in the Presence of Imperfect Information and Heterogeneity

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Abstract

Social networks can help institutions spread information about agricultural innovations and are increasingly thought of as a viable complement to traditional extension services. Taking advantage of experimental variation in the information available to farmers through their social networks, this paper examines the influence of social networks on knowledge about and adoption of a new agricultural technology in rural Kenya. The results suggest that networks affect several aspects of farmer knowledge and their adoption process, but that village-level variability in soil quality makes individuals less likely to respond to their peers' experiences. This finding indicates that policy-makers ought to take the variability of the environment into account when deciding whether to allocate resources towards leveraging social learning for information diffusion, or instead focus on encouraging learning-by-doing.

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Context

Approximately three-quarters of poor people in developing countries live in rural areas and depend at least in part on agriculture for their livelihoods (World Bank, 2008). Further, studies show that GDP growth originating in agriculture benefits the poor substantially more than growth originating in other sectors (Ligon and Sadoulet, 2008). Yet, despite many advances in agricultural technology, smallholder farmers still suffer from low productivity, which often leads to chronic poverty and food insecurity. These improved technologies could raise agricultural productivity to both lift poor households out of poverty and grow the economies in which they live, but adoption has been slow in poor countries, especially sub-Saharan Africa.

Understanding how farmers make their production choices is essential to designing effective interventions to promote new agricultural technologies to close yield gaps and reduce poverty. In particular, why don't smallholder farmers adopt technologies that have the potential to boost farm productivity and improve their household's welfare? One reason is that the market in which farmers make their choices is plagued by imperfections. The challenges faced by farmers include credit constraints, imperfect insurance markets, and incomplete information about the availability and profitability of new technologies. This research focuses on the last of these challenges, and examines under which circumstances social learning can play a role in diffusing information about a new agricultural technology. In particular, the study examines whether heterogeneity in underlying conditions affects farmers ability to learn from each other.

The study is built around a randomized roll-out of information about and samples of a private seed company's high-yielding maize hybrids. Until recently, the company faced production capacity constraints and therefore had a limited geographic reach. As a result, prior to this study, farmers in the study areas had neither been exposed to information about these new hybrid seeds nor had a chance to use them. Many blame Kenya's stagnating maize production on how slowly older hybrids are being replaced with newer releases. The relevant decision for farmers is therefore not simply whether to plant a hybrid, but what type of hybrid to choose. In contemporary Kenya, an average of over fourteen new maize varieties have been released on the market each year since 2000, making this a very complex choice. The choice is made even more difficult by the fact that the region being studied is characterized by significant differences in soil quality both within and between villages.

Study design

The study of social learning has grown in popularity over the past few decades, but can be difficult to identify. The primary challenge (detailed by Manski, 1993) is identifying whether members of a social network influence each other or whether they simply behave alike because they are already similar and face similar stochastic shocks (perhaps because of a shared environment or because the network was formed precisely based on the shared characteristics of its members). The key, then, is to identify whether members of a social network influence each other or whether they behave alike simply because they are alike, or are exposed to similar situations and environments. A growing set of papers vary experimentally the information available through social networks to cleanly pick up the effects of social networks (see, for example, Babcock and Hartman, 2010; Carter et al., 2014; Cai et al., 2015 and Magnan et al., 2015). They can then base their social network analysis on the number of members of an individual's network that were treated/received a piece of information, using this number as a proxy for the number of different sources of information to which a farmer has access.

I complement these prior methods with an additional measure of the information available through farmers' social networks. As part of my experiment, villages were randomly designated as either control or treatment villages. In treatment villages, only those farmers randomly selected for inclusion in the study were actually treated. Before the main planting season of 2013, the farmers selected for treatment were invited to an information session and given a 250-gram sample pack of the new seeds. In early 2014 I conducted a phone survey with treated farmers to learn more about their experience with the sample seeds. I then explicitly elicit farmers' experiences with the technology, obtaining the treated farmers' evaluation of how well the on-farm experiment went. Using this information, I construct a more precise measure of the information flowing through the network. Specifically, I calculate the percentage increase of the WSC hybrid harvest over the expected harvest with seeds the farmer would have normally used. The signal that a given farmer receives about the new technology is then defined as a function of the distribution of these evaluations in her information network.

Observing peer effects may reflect mimicry or social pressure rather than actual learning, but these more precise measures of information enable us to more carefully discern between social influence and social learning. We can do this by contrasting individuals' behavioral responses to the number of people who have experience with the new technology with their responses to the actual information transmitted through the network (the signal described above): If people respond to the number of people in their network who adopt a new technology, but not to information about the returns to this technology, then observed effects from the social network are likely to be a sign that mimicry, rather than social learning, is at work.

Findings

I find that social networks do impact farmers' adoption behavior, and that the signal appears to provide additional information – above and beyond the number of treated in one's network. The number of treated farmers in a respondent's network affects their willingness to pay (WTP) for the seeds and their probability of adopting the new technology[1] and the signal has additional effects on both WTP and on the probability of planting a hybrid. This lends support to the notion that farmers are indeed learning from each other and not merely mimicking what others are trying.

Further supporting this notion, I find that the observed social network effects are weaker in villages where soil quality is more varied. Observing or talking to one's neighbor may be more or less useful depending on how similar they are along dimensions that matter for the profitability of the technology. In other words, it is harder for individuals to learn from their network members about a technology that is sensitive to characteristics (such as soil quality) that are difficult to condition on if those characteristics vary in the population. Large variation in unobserved characteristics, like soil quality, could therefore negatively impact social learning.

For this analysis, I take advantage of detailed soil quality data on the treated farmers' fields. I interact the coefficient of variation in soil quality (proxied by the Cation Exchange Capacity, or CEC, a common measure of soil fertility). At low levels of soil quality variation, the average information signal in an individual's network positively influences adoption. As the variation increases, the impact of the average signal decreases. These results suggest that farmers are aware of this particular type of heterogeneity and that it affects how much they can learn from their social contacts.

Finding that this type of underlying het-

1. The effect on WTP is mostly seen for the indirectly treated farmers (the untreated farmers in treatment villages).

erogeneity handicaps social learning gives additional confidence that the social network effects that I observe are due to learning rather than imitation. It is unlikely that we would find a negative relationship between unobserved soil heterogeneity and social network effects if farmers were merely imitating their peers.

Implications for policy

Results showing that farmers talk to and learn from each other should come as no surprise. The extent to which heterogeneity in soil quality seems to handicap these social network effects, however, suggests that it is much harder for a farmer to make inference about how well a new technology will do on her own soil if she only observes its returns on soils that are very different from hers.

A better understanding of the complexities that farmers face when making input decisions is therefore key to understanding why some innovations diffuse more slowly than would be socially optimal. Farmers react to heterogeneity by relying less on information from their peers when making agricultural decisions. The more variable the environment, the more important learning-by-doing becomes. In this study, seed packet recipients were much more likely – ten percentage points – to purchase and plant the seeds in the next main season than the untreated in the same village.

This implies that in areas where soil type and other production variables varies significantly across farms, policy-makers should consider focusing their attention (and subsidies) on encouraging learning-by-doing, while in homogenous areas they might get bigger impact from the same spending by leveraging social learning. In the case of hybrids, this could be achieved by subsidizing learning or by making samples of seeds available to farmers for on-farm trials.

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