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Can mobile phones improve agricultural outcomes? Evidence from a randomized experiment in Niger

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ABSTRACT

The widespread growth of mobile phone coverage worldwide has offered new potential for increasing rural households' access to information and public and private transfers. Yet despite the proliferation of mobile phone-based interventions in the agricultural sector, there is mixed evidence on their impact. We report the results of a randomized evaluation in Niger, in which rural households increased their access to information technology and their capacity to use it. We find that households in treated villages planted a more diverse basket of crops, particularly marginal cash crops grown by women. This did not increase the likelihood of selling these crops or the farm-gate price received, suggesting that other market failures need to be addressed to improve farmers' welfare.

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Introduction

In developing countries, informal networks provide important means by which households and individuals share information on a variety of topics, although the costs of searching for this information are often high. Economists and policymakers alike have proposed a number of reasons for this costly search, including limited transport and telecommunications infrastructure. These costs make it difficult for households and individuals to engage in optimal arbitrage, resulting in excess price dispersion and potentially lower prices (for farmers) and higher prices (for consumers). Policymakers and development practitioners alike have attempted to address these information asymmetries and "trade entitlement failures" for agricultural households (Sen, 1976, 1981; Dreze and Sen, 1995) through promoting agricultural extension systems or market information services (MIS). Despite decades of investment in such programs, evidence of their impact on household welfare is mixed, possibly due to the irrelevancy or untimeliness of the information provided (Aker, 2010).

The widespread growth of mobile phone coverage over the past decade provides new opportunities to overcome these search and transaction costs, and the potential to improve welfare. In sub-Saharan Africa, it is estimated that over 60% of the population has access to mobile phone coverage, with 356 million unique phone subscribers (Wireless Intelligence, 2012). Mobile phones could reduce households' costs of searching for private information, especially as compared with traditional mechanisms, such as personal travel, newspapers or landlines. Similarly, they could improve farmers' access to public information by reducing the marginal cost of providing extension services or improving the timeliness of such information. Finally, with the introduction of mobile money services, mobile phones could improve farmers' access to private and public transfers, thereby allowing them to obtain access to credit when and where it's needed or to respond to shocks.

We report the results of a randomized evaluation in Niger, in which individuals were provided with access to shared mobile phones and learned how to use them, all in the context of an adult education program entitled Project ABC. In related work, Aker et al. (2012) showed that this program increased students' learning outcomes in both the short- and long-term. Yet in that work, we did not measure the impact of this program on other measures of well-being.

Overall, our results suggest that improved access to mobile phone technology, as well as learning how to use it, generates some economic benefits in rural agricultural settings for specific populations. We find that households in ABC villages planted more diversified crops as compared with their non-mobile phone counterparts. In particular, households were more likely to grow okra, a marginal cash crop grown by women. These effects were stronger

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among households that had not previously owned a mobile phone and where a female was the primary beneficiary, as well as among households living in villages where a market was not present. Households were also more likely to engage in sales of crops, though average quantities sold did not increase.

Prior evidence on the effect of information technology on entitlements, agricultural outcomes or food security is mixed. Goyal (2010) finds that the rollout of internet kiosks providing price information and quality-testing in India resulted in higher soybean prices for farmers. Jensen (2007) finds that the introduction of mobile phone coverage increased fishermen's sales prices and reduced their losses. Aker and Fafchamps (2014) find that the rollout of mobile phone coverage reduced farm-gate price dispersion in Niger, but did not affect farm-gate prices. Fafchamps and Minten (2012) find that while a mobile phone-based price and weather information system in India increased farmers' access to information and crop grading, it had no effect on other agricultural outcomes, including farm-gate prices. Camacho and Conover (2011) found similar effects of a SMS-based weather and price information system in Colombia. Only Cole and Fernando (2012) found that participating in a voice-based agricultural extension system affected farmers' input use and yields for some crops.

While seemingly contradictory, there is little theoretical reason to believe that access to mobile phone technology would lead to changes in agricultural behavior or an increase in farm-gate prices in *all* countries for *all* crops. If markets are well-integrated, then improved access to information would have no impact. However, if markets are poorly integrated, potentially due to high search costs, then improved access to information via information technology could allow farmers to bargain for higher prices, thereby creating incentives to use different inputs or produce more diverse crops. Yet even if arbitrage opportunities exist, improved access to information might not result in economic benefits for agricultural populations if markets are uncompetitive or if credit market failures exist.[1] Our findings indicate that improved access to information technology changes households' production decisions, but does not lead to a substantial improvement in economic benefits (which could lead to improved endowments and entitlements). Our findings are consistent with an environment where these other market failures might constrain households' production and consumption choices and entitlements.

The remainder of the paper is organized as follows: Section 'Research setting and design' provides background information on agricultural production and marketing in Niger, as well as information on the intervention and experimental design. Section 'Data and empirical strategy' describes the data and estimation strategy. Section 'Results' presents the results, whereas Section 'Alternative explanations' discusses alternative explanations and potential mechanisms. Section 'Discussion and conclusion' concludes.

Research setting and design

With a per capita GNP of US$230 and an estimated 85% of the population living on less than US$2 per day, Niger is one of the lowest-ranked countries on the United Nations' Human Development Index (UNDP, 2014). As the country spans the Saharan, Sahelian and Sudano-Sahelian agro-ecological zones, rainfall ranges from 200 mm (mm) per year in the north to 800 mm in the south. Precipitation varies substantially on an intra- and inter-annual basis (Nicholson et al., 2000). For example, Niger experienced six droughts between 1980 and 2005 (Government of Niger, 2007). Inter-annual deviations in rainfall are positively associated with fluctuations in agricultural output, as yields depend upon the timing and quantity of rainfall.

A majority of households in Niger depend upon rainfed agriculture, with staple food crops consisting of millet, sorghum and fonio, and cash crops including cowpea, peanuts, cotton and sesame. Most agricultural products in Niger are traded through a system of national markets, each of which is held on a weekly basis. On average, farmers live 10 km from the nearest market. Transport and search costs are quite high, in part due to the limited infrastructure: only 8% of roads are paved, and there are fewer than .2 landlines for every 100 people. Access to public information by way of agricultural extension services is similarly limited, with one extension agent for every 20,000 people (IFPRI, 2012). While women play an important role in the agricultural production and marketing process, particularly for marginal cash crops, women often have fewer opportunities to travel to markets and sell their output.

Intervention

Between 2009 and 2011, an international non-governmental organization, Catholic Relief Services (CRS), implemented an adult education program in two rural regions of Niger. The intervention provided eight months of basic literacy and numeracy skills in the native language of the village. Conforming to the norms of the Ministry of Non-Formal Education, each village had a separate literacy class by gender, made up of 25 students.

As a modification to the basic adult education program, a "mobile phone module" was added to the program, called ABC (Aker et al. 2012). As outlined in Aker et al. (2012), the ABC program taught students how to use a simple mobile phone and distributed a shared mobile phone (worth US$ 5) to a group of five students. The module was introduced into the classes three months after the start of the adult education program, and students did not have additional class time.

Experimental design

CRS identified 140 villages in Niger prior to the start of the adult education program. Among these villages, some already had an existing adult education program or did not have mobile phone coverage, which reduced the sample to 113 villages. Villages were first stratified by administrative division before being randomly assigned to a year cohort (e.g., 2009 or 2010), and were then assigned to either the basic (non-ABC) or mobile-phone "enhanced" (ABC) adult education program. Fifty-eight villages were assigned to the ABC intervention and 55 to the non-ABC intervention (Aker et al., 2012).

Eligible students were identified for both cohorts during the baseline. Individual-level eligibility was determined by whether the individual was illiterate, willing to participate in the program and a member of a formal or informal village-level producers' association. If there were more than fifty eligible applicants in a village, students were randomly chosen from among all eligible applicants in a public lottery.

By comparing outcomes of those households in ABC versus non-ABC villages, we can estimate the causal effect of the mobile phone module on agricultural production and prices of agricultural goods as compared to the standard adult education intervention. Since the ABC program involved distributing shared mobile phones and teaching students how to use these phones, we cannot disentangle

[1] In some cases the extent of these market failures will depend upon the perishability of a good. Goods that are more perishable are likely to be traded more locally and are likely to exhibit more temporal and spatial variation. While a reduction in search costs might reduce this variation, it could also extend the radius in which transportation is profitable more for non-perishable goods. As a result, the theoretical predictions with respect to the impact of ICT on price dispersion for perishable and non-perishable goods are ambiguous.

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