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Measuring risk attitudes among Mozambican farmers ☆

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ABSTRACT

Although farmers in developing countries are generally thought to be risk averse, little is known about the actual form of their risk preferences. In this paper, we use a relatively large lab-in-the-field experiment to explore risk preferences related to sweet potato production among a sample of farmers in northern Mozambique. A unique feature of this experiment is that it includes a large subsample of husband and wife pairs. After exploring correlations between husband and wife preferences, we explicitly test whether preferences follow the constant relative risk aversion (CRRA) utility function, and whether farmers follow expected utility theory or rank dependent utility theory in generating their preferences. We reject the null hypothesis that farmers' preferences follow the CRRA utility function, in favor of the more flexible power risk aversion preferences. If we make the common CRRA assumption in our sample, we poorly predict risk preferences among those who are less risk averse.

1. Introduction

Although it is generally assumed that farmers in rural areas of developing countries are risk averse, little is known about the actual form of their risk preferences. When economists attempt to measure risk preferences, they typically assume that risk preferences follow the constant relative risk assumption (CRRA) utility function (see Cardenas and Carpenter (2008), Delavande et al. (2011) or Hurley (2010) for recent reviews of the literature). However, the consequences of simply making this assumption without testing it are unclear. Few studies actually test risk preferences in the field without making the CRRA assumption. An important exception is Holt and Laury (2002) who consider a more flexible parameterization of the utility function, although they do so in a laboratory experiment setting.

Furthermore, it is likely that risk preferences among farmers in developing countries are important constraints that keep farmers from reaching their productive potential. Smallholders in developing countries face risk at several points in the production process. Dercon and Christiaensen (2011) explicitly show that Ethiopian farmers are constrained in technology adoption by risk. Furthermore, Boucher et al. (2008) argue theoretically that a class of farmers is risk-rationed in Peru; that is, due to risk, some farmers will not try to access the formal credit market, even if it would raise their productivity and income levels. Overcoming such barriers to risk, then, could help farmers in developing countries improve their livelihoods along several dimensions.

Understanding the heterogeneity of risk preferences and the implications of making specific assumptions about the form of risk preferences may have consequences as programs are designed to help farmers in developing countries overcome several different potential sources of risk. Several impact evaluations have recently been conducted on pilot projects related to weather insurance, with mixed success. Cole et al. (2013) test the importance of the insurance contract price on take up in India by randomizing price offers, and find that average take up in participating villages is around 25%, though almost no one takes up insurance in neighboring villages that did not receive a visit from insurance agents. Hill and Robles (2011) find similar take up (27%) in a pilot project in southern Ethiopia that offered small amounts of insurance, rather than attempting to insure the farmer's entire production. Additional information about the type and distribution of risk preferences among farmers might be important in informing the design of weather insurance contracts, to improve take up.

In this paper, we use experimental data collected in rural Mozambique to elicit risk preferences of farmers participating in an agricultural program that promoted orange fleshed sweet potatoes (OFSP). The experiment to elicit risk preferences was framed around the adoption of sweet potato varieties and consisted of presenting a menu of ordered lottery choices over hypothetical gains to the farmers. The data were collected in the final survey of a randomized evaluation designed to evaluate an intervention that provided farmers with OFSP vines, information about how to grow OFSP, and the relative nutritional benefits of consuming orange rather than white sweet potatoes, particularly for women of child bearing age and children under five years old. One unique aspect of the experiment is that it was conducted separately

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with both the household head and spouse when both were present. It was therefore conducted with 682 farmers from a total of 439 households. Within households in which both head and spouse were present, we examine the correlation between the husband's and the wife's preferences.

We use the data to consider and test several models of risk preferences against one another. We initially compare two contending models of choice under uncertainty, Expected Utility Theory (EUT) and Rank Dependent Utility (RDU). Quiggin (1982, 1993) have proposed a Rank Dependent Utility (RDU) framework that can be considered a generalization of EUT. Under RDU, subjective probabilities are not constrained to be equal to objective probabilities, as in EUT. Instead, agents are allowed to make their choices under uncertainty according to a nonlinear probability weighting function.[1] We then consider a general class of value functions that explicitly allows for variation in relative risk aversion, relaxing the assumption of constant relative risk aversion (CRRA) that is often made in the literature.

Our primary contribution to the literature is that we use data collected in a lab-in-the-field experiment to nest different potential models of risk preferences, and then we develop and test these models against one another. We are also able to examine risk preferences among the head and the spouse, and to consider whether they predict one another's risk preferences within this hypothetical context. We further construct a model that allows for heterogeneity in the theoretical basis for risk preferences; namely, EUT or RDU. Our experiment is related to the lab experiment conducted by Andersen et al. (2010), who conduct a lab experiment among 150 subjects and elicit both risk preferences and subjective probabilities, using real payoffs. In general, our finding is relatively consistent with both Kahneman and Tversky (1979) and Andersen et al. (2010); we find that the RDU dominates EUT, and we generally reject the hypothesis of CRRA, regardless of the form of preferences. We then show the magnitude of errors that take place if one assumes CRRA preferences. We find that farmers who are less risk averse are more susceptible to mischaracterization under the CRRA assumption than more risk averse farmers, based on the results of our model. Furthermore, we find that the risk premium implied by RDU is substantially higher than that of EUT, suggesting that one explanation for low take ups of rainfall insurance in developing countries may be a mischaracterization of risk preferences.

The paper proceeds as follows. The next section will discuss the literature on the measurement of risk preferences, both in the laboratory and in field experiments. The third section describes the setting in which the data collection and field experiment took place, as well as more details about both. The fourth section presents and discusses the results, and the final section concludes.

2. Measuring risk preferences in developing countries

A large body of literature characterizes risk preferences among residents of developing countries. In most cases, the EUT is used as a conceptual framework to frame risk preferences, although more recently some authors have also considered alternative utility frameworks for choice under uncertainty (Harrison et al., 2010; Liu, 2013; Tanaka et al., 2010). Previous work on characterizing risk preferences has been based either on the use of experimental lotteries or on the analysis of production decisions collected from household survey data. We will focus on the first line of work since this paper also uses experimental lottery data from the field. Here, we only summarize papers that are directly relevant to our analysis.[2]

Binswanger (1980, 1981) are among the first studies to provide formal tests of risk aversion among farmers in a developing country. The papers describe both hypothetical and real payoff lotteries to Indian farmers in which the outcome probabilities were fixed, but the payoffs of the lotteries varied. These studies found that most Indian farmers in the study were risk averse, and that the degree of risk aversion increased with the monetary payoff of the lotteries. Overall, these results suggested that farmers' choices were consistent with increasing relative risk aversion (IRRA) and decreasing absolute risk aversion (DARA).

Using similar procedures, Miyata (2003) and Wik et al. (2004) studied Indonesian and Zambian villagers, respectively. Confirming Binswanger (1980, 1981)'s findings, they also found that farmers' preferences are characterized by extreme to moderate degrees of risk aversion, by DARA, and by non-increasing or decreasing relative risk aversion.

Mosley and Verschoor (2005) studied three different countries (Ethiopia, India and Uganda), and combined choices over lottery pairs with hypothetical certainty equivalent questions. Similar to Binswanger (1980, 1981), they find no significant relationship between risk aversion and respondent characteristics such as age, gender, literacy, income or wealth. Responses obtained from the hypothetical certainty equivalent questions, however, do correlate significantly with the data collected through real payoff lottery choices. In contrast with the results found by other authors, Yesuf and Bluffstone (2009) used a data set collected in northern Ethiopia, and found that risk aversion is significantly correlated with respondent characteristics such as household composition, income and wealth.

Hill (2009) relied on stated preferences and beliefs to identify the effect of risk aversion on production decisions for a sample of Ugandan coffee growers. Using both nonparametric and regression analysis, she finds that higher risk aversion translates into a lower allocation of labor towards a risky perennial crop such as coffee. This effect dissipates among wealthier farmers. This result underscores the importance of understanding risk preferences for measuring specific farmer level outcomes.

More recently, Liu (2013), Tanaka et al. (2010), and Harrison et al. (2010) depart from the previously cited work to consider an alternative utility framework to EUT, in the form of Prospect Theory (PT) or RDU models. These studies also contrast with previous work in the way lottery choices are elicited. Instead of fixing the outcome probabilities and varying the lottery stakes, as proposed by Binswanger (1980), they follow Holt and Laury (2002) and use multiple price lotteries (MPL) in which the lottery payoffs are fixed in each choice task, and the outcome probabilities are varied. While Liu (2013) and Tanaka et al. (2010) analyzed the PT framework over the full range of gains and losses, Harrison et al. (2010) focused only on the gain domain, and they compared EUT to RDU by testing the non-linearity of the probability weighting function. Harrison et al. (2010) also estimated a finite mixture models allowing both EUT and RDU to explain some proportion of respondents' choices over risky lotteries.

In a similar experiment, Andersen et al. (2010) use an MPL and elicit subjective probabilities experimentally among 150 participants in a lab experiment, similarly estimating a mixture model and finding the RDU dominates the EUT. This paper differs from Andersen et al. (2010) in several ways. First, Andersen et al. (2010) use a weighting function not typically found in the literature. Second, whereas Andersen et al. (2010) conduct a lab experiment, this paper uses a lab-in-the-field experiment with a larger sample and radically different conditions under which the experiment took place. Finally, in this paper two members of the same household often participated in the experiment, whereas in a lab experiment individuals are not likely to be related.

In Table 1, we summarize some essential characteristics of the work cited above. Most of the previously mentioned studies rely exclusively on CRRA utility functions to compute coefficients of relative risk aversion. Under EUT, CRRA utility functions are convenient to work with because they summarize attitudes towards risk in a single parameter,

[1] RDU is related to prospect theory (PT) which further postulates that agents value risky lotteries differently in the gain and loss domain (Kahneman and Tversky, 1979). Since the experiment presented in this paper only takes place in the gain domain, we cannot empirically test EUT or RDU versus PT.

[2] See Hurley (2010) for a recent and more exhaustive review.