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Farmers' risk preferences and their climate change adaptation strategies in the Yongqiao District, China

Jin Jianjun [a,*], Gao Yiwei [a], Wang Xiaomin [a], Pham Khanh Nam [b]

[a] College of Resources Science and Technology, Beijing Normal University, Beijing, China
[b] Ho Chi Minh City, University of Economics, Viet Nam

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ABSTRACT

Farmers' risk preferences play an important role in agricultural production decisions. This study characterizes risk preferences among farmers in Yongqiao and determines how these risk preferences are related to their choices regarding climate change adaptation strategies. We find that most farmers in the study area were aware of climate change. They were taking measures to protect their livelihoods against perceived changes to the local climate. The risk experiment result shows that the representative subject was risk averse, and women were more risk averse than men. The relationships between farmers' risk preferences and different climate change adaptation choices were different. Farmers' risk aversion was negatively and significantly related with adaptation strategies on planting new crop varieties and adopting new technology, but it had a significantly positive effect on purchasing weather index crop insurance. The results also indicate that the level of education, farming experience, farm size, household income and perception of climate change impacts influence farmers' adaptation decisions.

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1. Introduction

Climate change has been acknowledged by the scientific community for quite some time. Extreme weather events and climate disasters are expected to adversely affect agricultural production (IPCC, 2007). China is a typical meteorological disaster-prone country and is highly exposed to natural disasters as well the potential impact of climate change. The effects of drought, flood and other natural disasters on agriculture have worsened since the 1990s (Liu et al., 2010). There is a general consensus that China's agriculture sector will be significantly affected by climate change (Edition Committee of China's National Assessment Report on Climate Change, 2012).

Adaptation is one of the policy options for reducing the negative impacts of climate change on agriculture (IPCC, 2007; Nicholas et al., 2012). A better understanding of farmers' perceptions of climate change, their ongoing adaptation measures and other related factors is important for informing policies that are aimed at promoting successful adaptations in the agricultural sector. To date, the studies that investigate farmers' adaptive behaviors and the factors influencing their climate change choices are limited in China (Tian and Chen, 2014). This study examines farmers' ongoing adaptation measures and the factors influencing their decisions to adapt. We use farmers in Yongqiao as a case study to bridge this knowledge gap and to guide policymakers regarding the promotion of adaptation.

In other domains, risk preference is a significant research topic and is identified as a main driver of farm management and land use decisions (Chavas et al., 2010). Extensive theoretical literature exists, within which farmers' risk preferences play a role in agricultural production decisions (Adger et al., 2009; Feder, 1980; Just and Zilberman, 1983). Evidence from broader risk preferences and climate change adaptation studies suggest that the risk preferences and socio-cognitive processes of decision-makers are important for motivating adaptation decisions (Frank et al., 2011; Grothmann and Patt, 2005; Patt and Schroter, 2008; Jordan and McDaniels, 2013). Thus, greater understanding of the link between Chinese farmers' risk preferences and how they respond to climate change adaptation is crucial for policymakers, particularly for designing effective adaptation measures (Chavas et al., 2010).

In determining the relationship between agricultural decisions and risk preferences, most of the empirical studies in the literature typically have two broad approaches for estimating risk preferences (for a review: Appelt et al., 2011; Charness et al., 2013). The first uses survey questions to elicit risk preferences by

* Corresponding author. Tel.: +86 10 58805049; fax: +86 10 58808178.
E-mail addresses: jjjin@bnu.edu.cn (J. Jianjun), mollygao2008@163.com (G. Yiwei), wangxm@mail.bnu.edu.cn (W. Xiaomin), pham.khanh.nam@economics.gu.se (P.K. Nam).

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Table 1
Experimental design.

Task	Option A	Option B	EV^A	EV^B	Risk aversion
1	20CNY	20CNY if heads; 0CNY if tails	20CNY	10CNY	–[a]
2	15CNY	20CNY if heads; 0CNY if tails	15CNY	10CNY	Very risk loving
3	12CNY	20CNY if heads; 0CNY if tails	12CNY	10CNY	Risk loving
4	10CNY	20CNY if heads; 0CNY if tails	10CNY	10CNY	Risk neutral
5	8CNY	20CNY if heads; 0CNY if tails	8CNY	10CNY	Slightly risk averse
6	6CNY	20CNY if heads; 0CNY if tails	6CNY	10CNY	Risk averse
7	4CNY	20CNY if heads; 0CNY if tails	4CNY	10CNY	Very risk averse
8	2CNY	20CNY if heads; 0CNY if tails	2CNY	10CNY	Highly risk averse

[a] A participant who choose option B in this row has misunderstood the task, since option A involves no uncertainty and the prize equals to the higher payment in option B.

asking individuals about personal traits that are directly related to risk aversion (e.g., Cesarini et al., 2009). However, the issue with this method is that survey questions are not incentive compatible. Economists are skeptical about whether self-reported personal attitudes and traits are behaviorally meaningful. The second approach uses experimental methods to observe the choices of subjects that reflect each individuals' risk preferences (Holt and Laury, 2002; Harrison et al., 2007). The advantage of experimental studies is that one can design experiments where many of the experimental factors are controlled by the experimenter. This ensures that the elicited risk measure is influenced only by risk preferences. There is a growing body of literature concerning the use of experimental data to elicit risk preferences in both developed and developing countries (Brick et al., 2012; Eckel and Grossman, 2008; Harrison et al., 2010; Holt and Laury, 2002; Yesuf and Bluffstone, 2009; Tanaka et al., 2010). One important objective of this paper is to characterize the risk preferences of farmers using the experimental method. We will then determine how these risk preferences are related to farmers' adoption of adaptation strategies in China. To the best of our knowledge, this is the first study that examines the effects of farmers' risk preferences on their climate change adaptation strategies in China.

The remainder of this paper is organized as follows. Section 2 describes the study area. Section 3 presents the research design and data collection. Section 4 reports the empirical results and discussions. The final section provides conclusions and policy implications.

2. Study area

The Yongqiao District was selected as the study area. It is the biggest county-level district in China, located in the northern Anhui Province (see Fig. 1). The total area of the district is 2868 square kilometers. The average yearly temperature is approximately 14 °C, and the annual rainfall is roughly 900 mm. In 2012, the population of the district was approximately 1880,000, among which agricultural populations accounted for 78%. The average per capita GDP was CNY 20,059(USD 3280). Wheat and corn are the two main crops in this area. In 2013, more than 90% of households grew wheat and over 85% grew corn.

Yongqiao lies in the Huaibei Plain and the Huai River watershed. The surface is generally undulating, and the soil is very porous, with a low water retention capacity. This makes the area vulnerable to floods and droughts. The main problems that affect stable crop harvests are heat waves during the crop's flowering phase in July and August and rainfall shortages. Due to the effects of climate change, farmers may face more risky situations in the future. Because agricultural production remains the main source of income for most rural communities in the region, adaptation is imperative to maintain and improve the productivity of the agricultural sector, protect the livelihoods of the poor and ensure food security.

3. Method and data collection

Respondents were selected randomly from two villages in the Yongqiao District. The two villages were selected because they were the only villages that were provided a trial for wheat drought weather index insurance, which is an important adaptation strategy (Botzen et al., 2009; Bryan et al., 2013; Panda et al., 2013). The two villages are large agricultural sites and very vulnerable to drought hazards. Because of the pilot promotion of the wheat drought weather index insurance, the coverage area has increased from 35% in 2011 to over 50% in 2012.

In most cases, we interviewed the head of the household, who typically did the most farm work. If the head of household mainly participated in off-farm work (i.e., leaves the village for work in larger cities), we interviewed the family member who was the most responsible for farm work. Each respondent was first asked to finish an individual survey. Then, they were asked to participate in a risk experiment, which took place after the conclusion of their interviews. The experiments consisted of choosing from a multiple price list (MPL). The risk preference elicitations were administered in a group setting in which the experimenter read instructions in front of the entire group. Each group included approximately 10 subjects. Choices were made individually and privately. The subjects were paid for their participation at the end of the experiment.

3.1. Survey instrument

Questionnaire surveys were used to collect the following information: (1) general information on farmers' perceptions regarding climate change; (2) the total area of the farmland operated by each household, detailed information on the types of crops planted in 2012 and corresponding area for each type of crop; (3)detailed information on respondents' self-reported adaptation measures; and (4) the demographic and socio-economic data of respondents and their households.

3.2. MPL design

3.2.1. Basic design

Our multiple price list (MPL) experiment was developed based on Brick et al. (2012), which is a variation of the widely used Holt–Laury-type measure (Holt and Laury, 2002). The MPL is a standard format, whereby subjects are provided with a fixed array of paired lottery options and choose one option per pair. The MPL design can be explained to subjects and implemented with relative ease. It also promotes honest answers (Andersen et al., 2006).

Table 1 presents the tasks that were presented to the subjects. They were asked to examine a total of eight options for comparison. For each binary-choice task, subjects would pick either option A (the "safe" option) or option B (the "risky" option). Given that subjects may have difficulty in understanding the concept of probability, the experiment was kept as simple as possible. Per Brick et al. (2012), fixed probabilities of 100% and 50% were used. We varied

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