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Risk-Taking Preferences of Farmers in Northern Thailand: Measurements and Implications

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Abstract

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Risk-taking preferences were elicited from small semi-commercial farmers in Northern Thailand using an experimental procedure that included real monetary payoffs of meaningful magnitudes. A total of five sets of lotteries with increasing payoffs were offered. The farmers were found to be risk averters, and their preferences conformed to the hypothesis of increasing (nondecreasing) partial relative risk aversion. Using regression analysis, farmers' expected variation of rice yields and farm size were found to be directly related to a decrease in risk aversion, while the extent of multiple cropping, availability of non-land household assets, and tested mathematical ability were found to be indirectly related to a decrease in risk aversion. The variables expected variation of rice prices, farmers' age, and tested abstract ability scores were not related to risk-taking preferences.

Introduction

There is a growing consensus in the agricultural economics literature that farm operators' preferences for risk taking are important in situations where uncertainties exist. Additional efforts need to be made in measuring and quantifying risk preferences. Knowledge of farmers' risk preferences is useful in the development of farm management and rural development strategies, development and transfer of technology, and policy formulation (Young, 1979). There

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is, however, no consensus on the appropriate methodology to use in measuring risk preferences. As noted by Pope (1982), the methodological development and application of risk preferences remain in the embryonic state even though a large number of studies have been made.

Methods used to measure risk preferences can be grouped into three general categories: (1) econometric models, (2) risk programming models, and (3) experimental elicitation approaches. The econometric approach is intuitively appealing in measuring attitudes and responses to risks. Pope (1982) suggested that structural models of factor demand and output supply will be useful in testing alternative theories of behavior under risk. However, comprehensive models have yet to be developed and tested. Significant difficulties remain to be overcome with regard to the source and nature of risks, form and arguments of the utility function, and problems associated with aggregating individual behavioral rules (Binswanger, 1982). Programming studies typically are based on the mean-variance model or its variants, the most popular being the MOTAD model (Hazell, 1971). Risk programming models are useful as a guide in analyzing responses to risks. Modeling actual operator behavior, however, has proven to be more difficult because of the need to specify the production structure, sources and distribution of risks, and manager's risk preferences. Hazell (1982) suggested a risk aversion parameter could be estimated with a programming model by selecting the parameter associated with the production plan resembling the actual production plan. However, choosing the correct specification of a firm's technology, risks, and behavior is most unlikely, as noted by Binswanger (1982).

As an alternative, experimental approaches have been developed to directly elicit risk-taking preferences. Earlier work in this area was carried out by experimental psychologists and is reviewed by Luce and Suppes (1965). In agricultural applications, simulated gambling situations have been used. Officer and Halter (1968), Dillon and Scandizzo (1978), and Bond and Wonder (1980) used utility theory approaches and elicited certainty equivalents of risky outcomes. In a seminal study by Binswanger (1980, 1981), working in India, a one-period gambling situation offering payoffs of meaningful magnitudes was used. Binswanger (1980) elected to use a gambling situation after discovering interview biases in a preliminary simulated gambling study similar to that of Dillon and Scandizzo (1978).

The experimental approach has been critized on the grounds that results from laboratory experiments tend to be artificial and therefore unrepresentative of economic behavior (Weick, 1967). Smith (1976) and Schoemaker (1982), however, both argue that behavior in a laboratory is as real as other forms of behavior. Experimental approaches using simulated gambling have also been critized by Robinson (1982) because they force decisionmakers to respond to hypothetical questions.

The purpose of this paper is to report on the results of an experimental method used to elicit risk attitudes of small semi-commercial farmers in Northern Thailand. To make the elicitation process meaningful, farmers were offered the opportunity to choose among lotteries with risky outcomes that included monetary payoffs of a realistic magnitude. This study is thus another application of the experimental gambling approach used by Binswanger (1980). [Similar studies using a gambling situation have since been carried out by Sillers (1980) in The Philippines and Walker (1980) in El Salvador.] The paper is organized into four sections. In the first section, concepts of theoretical measures of risk aversion are reviewed. The area of study and elicitation method are described in section two. Section three contains the main results and section four presents a summary and conclusion.

Theoretical measures of risk aversion

The basis of behavioral research on risk attitudes is the Bernoullian utility model originally developed by Bernoulli and the subsequent set of behavioral axioms proposed by Von Neumann and Morgenstern (1953). A theoretical measure of risk aversion was proposed by Pratt (1964) and Arrow (1965) based on Bernoullian utility theory. They defined absolute risk aversion as

$$R(x) = -U''(x)/U'(x)$$

where U is a von Neumann-Morgenstern utility function with properties $U' > 0$ and $U'' < 0$ and x is the wealth or income position. Both Pratt (1964) and Arrow (1965) hypothesized that a risk-averse decisionmaker would display decreasing (nonincreasing) absolute risk aversion for increases in x. The index is positive, zero, or negative for risk averters, risk neutral, and risk takers, respectively.

Following the works of Pratt (1964) and Arrow (1965), Menezes and Hanson (1970) and Zeckhauser and Keeler (1970) proposed a related measure of risk aversion referred to as partial relative risk aversion (PRRA). It is defined as

$$\text{PRRA} = -t\, U''(x+t)/U'(x+t)$$

where U and x are as previously defined and t is an income associated with a new prospect that is increasingly risky for increases in its payoff. Both Menezes and Hanson (1970) and Zeckhauser and Keeler (1970) hypothesized that a risk-averse decisionmaker would display increasing (nondecreasing) PRRA for increases in the prospect t. The indexes of absolute risk aversion and PRRA are related. A decisionmaker who exhibits decreasing absolute risk aversion would also be increasingly partial relative risk averse. The hypothesis of increasing PRRA will be tested in this paper.

TABLE 1

Lotteries, frequency of choices, and measures of risk aversion

	Lotteries											Mean	Variance
	1	2	3	4	5	6	7	8	9	10	11		
I. Lotteries at game level five (baht)[a]													
50%	200[a]	180	160	140	120	100	80	60	40	20	0		
50%	200	262	338	368	413	453	490	522	550	577	600		
II. Frequency of choices by game level[b] (%)													
Real 1	10.26[c]	17.95	15.38	2.56	5.13	0	7.67	2.56	2.56	7.69	28.21	6.21	15.44
Real 2	2.56	0	25.64	5.13	5.13	2.56	12.82	0	12.82	5.13	28.21	7.31	11.09
Hypo 3	12.82	7.69	12.82	7.69	7.69	7.69	0	12.82	7.69	10.26	12.82	5.92	12.66
Real 3	2.56	5.13	5.13	15.38	5.13	28.21	5.13	2.56	2.56	7.69	17.95	6.51	8.70
Hypo 4	5.13	10.26	17.95	5.13	17.95	5.13	5.13	0	2.56	7.69	23.08	6.08	11.09
Real 4	0	0	43.59	15.38	17.95	10.25	0	5.13	0	0	7.69	4.69	5.29
Hypo 5	12.82	28.21	10.26	0	25.64	7.69	2.56	0	5.13	2.56	5.13	4.21	8.07
Real 5	2.56	0	10.26	0	41.15	30.77	2.56	2.56	5.13	0	0	5.33	2.22
Hypo 6	10.26	25.64	15.38	17.95	15.38	2.56	5.13	0	0	5.13	2.56	3.82	6.15
III. Partial risk aversion (s)													
	8.3458	4.1729	1.5233	0.9225	0.6210	0.4381	0.3040	0.1893	0.1215	0.0667	0		
IV. Proportional insurance premium (PIP)													
	0.333	0.263	0.203	0.153	0.112	0.078	0.050	0.030	0.017	0.005	0		

[a]1 Baht equaled US$0.05 (in 1980).

[b]Real indicates an actual payoff and Hypo indicates no actual payoff was offered.

[c]Percent.

The area of study and elicitation procedure

During 1978, 39 farmers from two villages (hereinafter referred to as Village A and Village B) in the Chiang Mai Valley of Northern Thailand were selected for interview. Twenty farmers were randomly selected in each village from the population of farmers having 10 rai or less (one rai equals 0.2 ha). One farmer in Village A was voluntarily dropped from the sample after the start of the survey. The two villages were selected because of their close cooperation with the Multiple Cropping Project of the Faculty of Agriculture at Chiang Mai University. The farms were similar in size, crops planted, and farm wealth or asset position. The major difference between the two villages was that Village A had a more adequate irrigation water supply during the second or cool, dry season. The major crops produced during the second season were tobacco, soybeans, hybrid rice, cabbage and peanuts. During the first season, which coincides with the monsoon rains, most of the land was allocated to rice production. Crop production during the third or hot, dry season was limited, occurring only in areas where irrigation water was available.

The elicitation procedure can best be understood by examining the lotteries in panel I of Table 1. A set of eleven different lotteries, each with a 50/50 outcome, is shown. In total, five different sets of lotteries were used in the interviewing process. Each set of lotteries will be referred to as a "game" with the set shown in Panel I being game number five. Game four was derived by dividing both branches of the lotteries in game five by the number three. Thus each lottery in game four is one-third the value of the respective lottery in game five. Values for the lotteries of lower number games were derived in a similar manner. The lotteries in game five are thus 81 times the respective lotteries in game one.

Farmers were offered the opportunity to participate in the five games over a period of five weeks, starting with game one. The eleven lotteries for game one were written on individual cards to eliminate any biases that might result from the principal of central tendency. The farmers were asked to examine the individual lotteries and be prepared to indicate a preference to the investigator after a period of four days. The purpose of the delay was to simulate the actual process of decision making. Few farmers make major decisions on the spur of the moment without consulting family members and trusted friends. After indicating a preference, farmers were told they would be offered a fair coin to toss, determining the outcome of the preferred lottery. They would then be paid the sum of money as indicated by the outcome of the coin toss. As expected, the farmers had little difficulty in understanding the procedure. To encourage farmers to feel they had something to loose, they were given the sum of money for lottery one, which had no uncertainty associated with the outcome, at the time they were given the set of lotteries. To select a different lottery, a farmer would have to return the money given for lottery one which he had kept for four days. This process was continued for each of the five games, with the exception that a full week was allowed to form preferences at game levels four and five. Farmers were not told before or during the experiment the total number of games to be eventually offered.

Eleven lotteries were offered at each game level to differentiate between farmers who held approximately similar risk-taking preferences. A larger number of lotteries would have allowed for a more exact ordering of preferences. [After observing the farmers arrive at preferences, it was evident that they could have dealt with many more alternatives. Typically, they separated the eleven alternatives into three groups of closely related options. They eliminated first one group, then another, and selected the preferred alternative from the remaining group.] To ensure that the lotteries from one through eleven were increasingly risky, one branch was increased exponentially and the other decreased linearly.

The five games with increasing payoffs were offered to determine risk preferences over increasing risky situations. There was both an increase in risk and return for each lottery across the set of five games. If farmers are increasingly PRRA, it would be expected more risky lotteries would be preferred at lower game levels and less risky lotteries at higher game levels.

To determine if farmers' preferences were influenced by the offer of monetary payoffs, the next higher game was played for a hypothetical payoff prior to the coin toss for the game presently under consideration. That is, before the coin was tossed for game two the farmer was given the eleven lotteries for game three and asked to indicate his preference. Farmers were told in advance that no monetary payoff would be forthcoming. This method also permitted an observation of preferences for hypothetical lotteries with payoff levels three times the value of the lotteries in game five.

Results

Partial relative risk aversion

As noted above, it has been hypothesized that absolute risk-averse decision-makers are increasingly (nondecreasing) PRRA. Two methods that do not rely on a specific form of a utility function are used to test this hypothesis. First, changes in lottery preferences from lower to higher games over the five games offered were examined. If farmers prefer a lower numbered lottery from one game to the next, they are displaying increasing PRRA. No change in preferred number lotteries from one game to the next implies constant PRRA, which is defind by Menezes and Hanson (1970) and Zeckhauser and Keeler (1970) as nondecreasing PRRA. The second method is to statistically test for differences in the sample means of the preferred lotteries from one game to the next. No statistical differences between two means indicates, on average, con-

TABLE 2

Changes in preferred lotteries between games

Games compared	Village A		Village B	
	Equally or less risky	More risky	Equally or less risky	More risky
1 to 2	12	7	9	11
1 to 3	13	6	5	15
1 to 4	16	3	9	11
1 to 5	15	4	6	14
2 to 3	16	3	9	11
2 to 4	17	2	12	8
2 to 5	17	2	10	10
3 to 4	18	1	13	6
3 to 5	14	5	12	8
4 to 5	9	10	9	11

stant PRRA, while a rejection of the hypothesis implies increasing (decreasing) PRRA if the mean preferred lottery was smaller (larger) than that of the previous game.

Changes in preferred lotteries from lower to higher game levels for both villages are shown in Table 2. For Village A, a majority of farmers indicated preferences that were equally or less risky across the pairs of games played for a monetary payoff. The exception was choices between games four and five where ten farmers preferred a more risky lottery and nine preferred a lottery with equal or less risk. These results imply that most farmers exhibited increasing or constant PRRA over game levels one through four and decreasing PRRA when moving from game levels four to five. The latter result was not expected. In Village B, the results were more contradictory. On average, farmers indicated preferences for low number or less risky lotteries in game one. Comparisons between game one and all higher games showed preferences that were more risky. A similar result was shown between games two and three. These results imply that most farmers exhibited decreasing PRRA, a contradiction of what was hypothesized. However, more farmers preferred less or equally risky lotteries at game levels four and five when compared to preferences at game level three. As found in Village A, more farmers preferred a more risky lottery at game level five as compared to preferences at game level four. What conclusion can be drawn from these results? If we ignore Village B's preferences at game level one, then a majority of farmers in both villages exhibited constant or increasing PRRA at game levels up to game four and decreasing PRRA when moving from games four to five. Overall, more farmers in Village A preferred lotteries over the five games that indicate constant or increasing PRRA than did farmers in Village B. [During the final visit, ten farmers in each village were offered an opportunity to play a slightly different version of game level five. After they had indicated their preference, they were offered an opportunity to take the sum of money equal to the expected value of their preferred alternative instead of proceeding with the tossing of the coin. Since a risk averter would prefer the expected value of a lottery over the lottery itself, it would be expected that all the farmers would prefer the expected value. However, only one of the twenty farmers preferred the expected value. To justify their choice, they indicated that consideable effort had been spent in arriving at a choice and that they did not want to reconsider the decisionmaking process again. This reasoning suggests that carefully laid plans are not easily changed, even if a better opportunity is offered.]

Consider now the tests for equality in means and variances of all game pairwise comparisons shown in Table 3. The mean preferred lotteries in both villages were 6.21, 7.31, 6.51, 4.69 and 5.33 for games one through five, respectively (Panel II, Table 1). On average, increasing PRRA was exhibited between games one and four, two and four, two and five, three and four, and three and five. Decreasing PRRA was exhibited between games one and two and four and five. The latter results do not conform to hypothesized behavior and warrants further explanation. Before farmers were asked to indicate preferences for game five, they were asked to reveal the amount of cash on hand. More than one-third had less than 25 baht ($1.25) and most had less than 100 baht. Given these low cash positions, the amounts offered in the lotteries were of a substantial amount even if the most unfavorable outcome occurred. The offering of large sums at game level five may have increased the farmers' perceived wealth position, resulting in a decrease in absolute risk aversion as hypothesized by Pratt (1964) and Arrow (1965).

If the elicitation procedure was unbiased in measuring risk-taking preferences across the two villages, there should be no significant difference between the mean preferred lotteries at each game level, given that the farms in the two villages were homogeneous. The results for the test of equality between means at each game level are shown in Table 3. A significant difference was found at game levels one and two, but not at the three higher game levels. Thus, at game levels with larger and more meaningful payoffs, preferences tended to be similar for the two villages. Differences at lower game levels might be expected given the novelty of the experiment and the low payoffs offered.

To investigate if farmers as a group tended to become more homogenous in preferences over the five game levels as the game level increased, a test for equality of variances between the games was conducted. As shown in Panel II of Table 1, the variances decreased for increases in the game level. No significant differences were found between the variances of games one and two, two and three, and three and four (Table 3). All other between-game variance tests were significant. These results indicate that the farmers became more homogenous in their risk-taking preferences when larger payoffs were offered. Sig-

TABLE 3

Tests for equality of means and equality of variances between game levels and across villages

Game level[a]	Mean between games (t-statistic)	Mean across villages (t-statistic)	Variance between games (F-statistic)	Variance across villages (F-statistic)
Real 1 and 2	−1.78**		1.40	
Real 1 and 3	−0.42		1.78**	
Real 1 and 4	2.09*		2.94*	
Real 1 and 5	1.35		6.95*	
Real 2 and 3	1.47		1.27	
Real 2 and 4	4.45*		2.10*	
Real 2 and 5	3.84*		4.96*	
Real 3 and 4	4.58*		1.65	
Real 3 and 5	2.49*		3.89*	
Real 4 and 5	−1.97*		2.37*	
Hypo 3 and Real 3	−1.25		1.45	
Hypo 4 and Real 4	2.84*		2.39*	
Hypo 5 and Real 5	−2.62*		3.62*	
Hypo 6 and Real 5	−5.04*		2.76*	
Real 1		3.32*		1.18
Real 2		3.19*		1.34
Real 3		0.98		1.14
Real 4		0.91		1.19
Real 5		1.08		1.15
Hypo 3		2.12*		1.18
Hypo 4		0.86		1.75
Hypo 5		2.24*		2.64*
Hypo 6		0.20		1.41

[a]Real indicates actual payoff offered; Hypo indicates hypothetical payoff offered.
*Significant at the 0.05 probability level; **significant at the 0.10 probability level.

nificant differences between variances were also found between games with real and hypothetical payoffs. The variances of the latter were greater than those of the former. [Another reason why farmers tended to arrive at similar preferences is that there may be "social risk" associated with selecting an alternative that is altogether different than that selected by other farmers in the same village. Two different risks are involved in arriving at a choice. The first is the risk embodied in the alternatives themselves, and the second is the risk (i.e. the social risk) the farmer perceives to be associated with other villagers' attitudes toward his preferences. As an example, consider the purchase of an automobile by an individual. When deciding which automobile to purchase, the individual knows that there is a risk that the car may be mechanically defective, but there is also a risk that the characteristics of the car may not be acceptable to his friends.]

By offering the games for hypothetical payoffs before offering them for real payoffs, the affect of actual offerings of money on revealed preferences can be investigated. Games one and two were offered for real payoffs only to initially establish credibility with the farmers. Equality of means tests for the real and hypothetical games at levels three, four, and five are shown in Table 3. No significant difference between means was found at game level three. At game levels four and five a significant difference was found. In game four the hypothetical payoff mean was greater than the real payoff mean and in game five the reverse occurred. The results are thus contradictory and using the preferences indicated at game level six with a hypothetical payoff may not reliable.

The outcome of the selected lottery at any game level is independent of outcomes of other game levels. However, preferences at a higher game level are not necessarily independent of previous outcomes since the experience of winning or losing may affect future preferences. To test the hypothesis that the outcome of an earlier decision affects future decisions, we correlated, first, the outcome (i.e. heads or tails of the coin toss) and, secondly, the actual payoff or winnings of the previous game with the preferred lottery of the higher game. The simple correlation coefficients are shown in Table 4. In only one case was there a significant correlation – that between the payoff of game one and the preferences for game two. These findings imply that the farmers' revealed preferences at each game level were independent of the outcome or payoff of the preceding game. However, positive and significant correlations were found between preferred lotteries of adjacent game levels (Table 4). That is, preferences for risky lotteries at one game level were directly related to selected risky lotteries in the previous game. This finding indicates that farmers tended to select equally risky alternatives when going from one game level to another.

Positive and significant correlations were also found between the preferred lotteries at the same game level when hypothetical and real monetary payoffs were offered (Table 4). Farmers choosing a higher-numbered lottery for a hypothetical game also selected a higher-numbered lottery when the game was played for real.

Measuring risk preferences

A meaningful measure of risk preferences should conform to the Pratt–Arrow index of absolute risk aversion and be quantifiable from observed behavior. Given that the number of observations on preferences in this study are limited to five for each farmer interviewed, a direct estimation of the utility function may not be reliable. As an alternative, two methods suggested by Binswanger (1980) and Sillers (1980) will be used to quantify risk preferences. The first is a utility-free measure and will be referred to as the proportional insurance premium (PIP). For a specific lottery at any game level, PIP is calculated as the difference between the risk-neutral lottery (i.e. lottery 11) and the lottery

TABLE 4

Correlation coefficients between outcomes and payoffs of preferred lotteries

Variables correlated[a]	Correlation coefficient
Outcome 1 and Real 2	0.12
Payoff 1 and Real 2	0.35*
Outcome 2 and Real 3	0.10
Payoff 2 and Real 3	0.20
Outcome 3 and Real 4	−0.15
Payoff 3 and Real 4	−0.10
Outcome 4 and Real 5	0.09
Payoff 4 and Real 5	0.18
Real 2 and 2	0.45*
Real 1 and 3	0.15
Real 1 and 4	0.02
Real 1 and 5	0.12
Real 2 and 3	0.43*
Real 2 and 4	0.19
Real 2 and 5	0.30**
Real 3 and 4	0.35*
Real 3 and 5	0.58*
Real 4 and 5	0.49*
Hypo 3 and Real 3	0.61*
Hypo 4 and Real 4	0.53*
Hypo 5 and Real 5	0.36*
Hypo 6 and Real 5	0.66*

[a]Outcome indicates the result of the coin toss (heads or tails); payoff is the actual sum of money paid for that game; Real indicates actual payoff offered; Hypo indicates no payoff offered; and 1, 2, 3, 4, and 5 indicate game levels.
*Significant at 0.05 probability level; **significant at 0.10 probability level.

in question, divided by the risk-neutral lottery. As an example, PIP for lottery 5 of game five shown in Panel IV of Table 1 is calculated as

$$\mathrm{PIP}_5 = \frac{E(\mathrm{L}_{11}) - E(\mathrm{L}_5)}{E(\mathrm{L}_{11})} = \frac{300 - 266.5}{300} = 0.112$$

where E is the expected value operator and L_{11} and L_5 are lotteries 11 and 5. The PIPs for each of the 11 lotteries are shown in Panel IV of Table 1. Since successive game are multiples of three, the PIPs for each lottery across the five games remain constant.

The second method is based on the partial relative risk aversion index. In the above analysis it was shown that farmers exhibited constant or increasing PRRA over the game levels one through four and decreasing PRRA from games four to five. Given these results, risk preferences are measured using a constant partial relative risk-averse utility function $U(x;\, s) = (1-s)x^{(1-s)}$, where s is the parameter of the function and is equal to the PRRA index $-t\, U''/U'$ for all values of x (Binswanger, 1980). The value of the parameter s is calculated by setting two neighboring lotteries equal to each other and solving. The method necessarily assumes a decisionmaker is indifferent between a specific lottery and its neighbor. The value of the parameter for a specific lottery is the mean of the two neighboring lotteries values of s. A smaller value of s implies a decrease in risk aversion. Calculated values of s for each lottery are shown in Panel III of Table 1. Since the parameters for lotteries one and eleven cannot be calculated directly, the value for the former was arbitrarily set at twice the value of lottery two and the value of the latter was set at zero, implying risk neutrality.

Socioeconomic characteristics and risk aversion

It was shown that all the farmers surveyed were risk averse. Why decisionmakers are risk averse and what factors influence decisionmaker risk preferences are important questions. Decisionmakers' attitudes toward risk taking are developed over an extended period of time and are thought to be relatively stable over short time horizons. Defining the set of factors that influence risk attitudes is difficult, since many are part of the psychological makeup of the individual. However, there are several observable physical and economic factors that might influence risk attitudes.

Eight socioeconomic characteristics of the farmers surveyed were identified and included in a least-squares regession to determine their relationship with the previously quantified measures of risk preference. The characteristics were the standard deviations of rice yields and prices, farmers' age, extent of multiple cropping, farm size, total non-land household assets, and tested mathematical and abstract thinking ability. The standard deviations of the current year's traditional rice crops price and yield were included as measures of risks that farmers face in production and marketing and securing subsistence food needs. The standard deviations were calculated from a subjective probability distribution elicited directly from each farmer. [See Grisley and Kellogg (1983) for a description of the elicitation procedure]. The age variable is defined as farmers' age in years and the farm size variable is defined as the number of rai under production. Multiple cropping is a dummy variable which takes a value of zero if a single crop was produced during the second season and a one otherwise. The total non-land household asset variable is defined as the summation of cash on hand, market value of rice in inventory, market value of farm equipment and livestock minus all farm and nonfarm debts. The value of owned land and household dwelling were not included because of unavailability of this data. The mathematical and abstract ability variables are defined as the percent correct on an administered practical mathematics test and an abstract ability text. [See Raven (1962) for a description of the abstract ability test.]

TABLE 5

Regression estimates of socioceonomic characteristics and risk aversion

Independent variable	Proportional insurance premium (PIP)[a]	Partial risk aversion (s)[a]
Intercept	0.023	−0.310
Standard deviation price	−0.009	0.050
	(0.46)[a]	(0.22)
Standard deviation yield	−0.006	−0.022
	(1.66)**	(0.49)
Age	0.009	0.007
	(0.53)	(0.67
Multiple cropping	0.033	0.411
	(1.89)**	(1.90)**
Farm size	−0.010	−0.124
	(2.70)*	(2.70)*
Total non-land household assets	2.495E-06	1.679E-05
	(2.07)*	(1.13)
Mathematical ability	0.002	0.019
	(2.37)*	(2.09)*
Abstract ability	−0.004	−0.007
	(0.60)	(0.96)
R^2	0.45	0.35
F	3.08	2.02

[a]Numbers in parentheses are t-values.
*Significant at the 0.05 probability level; **significant at the 0.10 probability level.

These variables were included to represent farmers' ability to conceptualize and analyze uncertain situations.

The relationship was estimated first with the proportional insurance premium (PIP) calculated at the geometric mean of the preferred alternatives over game levels two through five as the dependent variable, and secondly with the constant partial risk aversion parameter s calculated at the geometric mean over game levels two through five as the dependent variable. The results of the estimations are given in Table 5. For the model with the PIP as the dependent variable the standard deviation of rice yield, multiple cropping, farm size, total non-land household assets, and mathematical ability were individually significant at the 10% probability level or above. The negative sign of the standard deviation of yield implies that farmers who expect to face greater yield risks are less risk averse. While this may not be obvious, if these farmers were willing to enter into production, then they must have been less risk averse in order to undertake the investment. Otherwise, their aversion to risk may have impeded them from accepting the prevailing expected risks. The multiple cropping variable had a positive sign, implying that more risk-averse farmers engaged in multiple cropping. This may be reasonable if farmers are undertaking multiple cropping for purposes of minimizing crop yield and price risks. The farm size variable had the expected negative sign, implying that larger farmers were less risk averse. An increase in the magnitude of the non-land household asset variable was hypothesized to increase an individual's willingness to take risks. Pratt (1964) and Arrow (1965) hypothesized decreasing absolute risk aversion for increasing levels of wealth. However, the sign of the variable was positive, implying that an increase in the value of the assets held was associated with a decrease in risk aversion. The positive sign of the mathematical skills variable may relate to farmers' assessment of the outcome of the offered lotteries. Farmers with better mathematical skills generally preferred lotteries with a smaller expected value and less variability.

In the model with the partial risk aversion parameter s as the dependent variable, the multiple cropping, farm size, and mathematical ability variables were found to be significant. Surprisingly, abstract thinking ability was not significant in either model. Hypothesizing the sign of this relationship is difficult since one could argue that better ability to think through abstract problems could lead to an increase or a decrease in a willingness to engage in risky prospects.

These results can be compared to the previous efforts at correlating risk aversion and socioeconomic characteristics by Binswanger (1980) and Walker (1980). Using the log of the partial risk aversion measure, Binswanger (1980) found that farmers' personal characteristics did not explain much of the variation in risk preferences. At the game level with the highest payoffs, only two of sixteen variables, a village dummy and perceived luck variable, were significant. The estimations by Walker (1980) also showed that little of the variation in risk preferences was explained by farmers' personal characteristics. Our results, while stronger than those of Binswanger (1980) and Walker (1980), should be interpreted with care given that the sample contained only 39 farmers. In addition, the expected signs of the independent variables are open to debate since they cannot be determined theoretically.

Conclusions

Farmers' preferences for risk taking were elicited using a procedure which closely followed that of Binswanger (1980). The main conclusions of the study are as follows: (1) all farmers are risk averse at payoff levels that were meaningful; (2) on average, farmers exhibited constant or increasing partial risk aversion over the five game levels; (3) as the magnitude of the monetary offerings increased, farmers' preferences tended to converge toward homogeneity; and (4) farmers' expectation of rice yield variability, extent of multiple cropping, farm size, total non-land household assets, and indicated mathematical ability were significant in explaining the variability of farmers' risk preferences.

While the results found in this study indicate that farmers are risk averters, they have not been used in an analysis of how farmers actually behave in the allocation of inputs and use of new technology. If this experimental procedure is to be used successfully and extrapolated to farming decisions, it will be necessary to show how the "experimental" risk-taking preferences are related to actual farm decisionmaking behavior under uncertainty.

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