FACTORS AFFECTING FARMERS' RISK-INCOME PREFERENCES*

by

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ABSTRACT

Risk-income preferences are derived from 91 Central Indiana farmers using magnitude estimation. Variability-income and bankruptcy-income measures developed are related to socioeconomic variables. Wealth and education have limited effects compared with off-farm employment, percent debt, and expected levels of income, percent debt and net worth growth.

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Agricultural economists have been interested in farmers' risk-income preferences and effects of these preferences on decision-making for many years. However, as indicated by Roumasett, there is no consensus regarding how to measure risk and risk preferences. Risk has sometimes been viewed as the variance or another measure of dispersion of possible outcomes. Alternatively, risk has been viewed in a "safety first" context as the chance of loss or possibility of disaster. Furthermore, as reviewed by Young, there has been a considerable discussion of alternative methods of measuring risk preferences. A limited number of studies have estimated farmers' risk preferences: only Moscardi and de Janvry; Dillon and Scandizzo; Binswanger; Halter and Mason; and Whittaker and Winter have focused on relationships between farmers' attributes and risk preferences.

This paper presents results of a study of factors affecting risk-income preferences. Unlike previous studies which are based on the expected utility framework, the risk-income preferences are measured by the magnitude estimation technique (Stevens). Risk-income indices are developed using both the variability of possible outcomes and possibility of disaster concepts of risk. The first section of this paper reviews studies using alternative methods of estimating farmers' risk attitudes and factors found to influence these attitudes. Second, the procedures used to measure risk-income preferences are described. The third section presents the empirical results, and implications are discussed in the final section.

Measuring Risk-Income Preferences

Direct elicitation of utility functions, experimental methods and observed economic behavior are methods which have been used to derive infor-

mation about risk-income preferences of individual farmers. Various techniques have been used to elicit utility functions (Dillon), but there has been considerable discussion of the merits of these techniques (Young). The utility functions elicited do not permit interpersonal comparisons concerning risk attitudes, but Pratt developed a measure of risk aversion which does. Given a utility function for money, U (M), the Pratt coefficient, r (M), is defined as the negative ratio of the second derivative of the utility function to the first derivative or r (M) = -U"(M)/U'(M). A Pratt risk aversion coefficient is defined for a specified money amount and allows interpersonal comparisons of risk attitudes.

Halter and Mason used the modified-Ramsey technique to elicit individual utility functions and computed Pratt coefficients for a sample of 44 Oregon farmers in 1974. Eleven farm and operator characteristics were analyzed in regression analyses with the Pratt coefficients as the dependent variable. Percent of land owned, education and age were statistically significant in linear form. Education squared and the education-percent ownership and education-age interaction factors also had significant effects on the Pratt coefficient. Whittaker and Winter reported on a follow-up study in which similar utility elictation procedures were used for the same sample of farmers in 1976. In their analysis, they found that all the estimated regression coefficients' signs reversed from the 1974 to 1976 data. They suggest a variety of possible causes of the differences in the results obtained and hypotheses to be tested.

Dillon and Scandizzo utilized the basic technique of directly eliciting utility functions, but did not actually estimate individual utility functions. A series of risk attitude coefficients for a sample of sharecroppers and landowners in Northeastern Brazil were derived from the individual's risk

premium, the risky prospect's expected value minus its certainty equivalent. The farmer's age, income, household size, and ethical attitude toward betting were socioeconomic variables used to explain risk attitudes in equations representing marginal and average measures of risk aversion. When subsistence was at risk, an increase in riskiness increased the required risk premium for both tenure groups. Ethical beliefs against gambling and age also had similar effects for both groups. Increases in income caused the risk premium to fall and household size had mixed effects. They concluded that most, but not all, peasants are risk averse and that the distribution of risk attitudes is not well represented by the mean. Income and possibly some other socioeconomic variables influence attitudes toward risk.

Binswanger attempted to utilize an interview procedure similar to that used by Dillon and Scandizzo, but found it unreliable in India. Like Roumasset, he found results varied substantially with the interviewer. To avoid these difficulties, he developed an "experimental" method which involved the use of actual financial compensation at realistic levels. With the experimental method, the gamble chosen by the respondent indicates the approximate level of partial risk aversion.

Binswanger found risk aversion tended to increase as the stakes of the game increased and all but one of 118 individuals were risk averse. About three-fourths of the individuals were intermediate or moderately risk averse. Binswanger then attempted to explain differences among individuals in their attitudes toward risk in terms of age, schooling, assets, land rented, salaried employment, working age adults per family, progressiveness, net transfers, luck in previous games and whether an individual liked to gamble. These variables were used in a number of cross-sectional regressions.

Although only a small portion, 5 to 21 percent, of the variation in the partial risk aversion coefficients was explained, in most instances schooling and good luck in prior games tended to reduce risk aversion. Wealth and the other variables had only modest quantitative impacts on risk aversion.

Moscardi and de Janvry developed an indirect measure of risk preference based on observed economic behavior. Working from a safety first framework they derive a relationship in which

$$K = [E\ (MVP_i) - MFC_i]/I_r$$

K is the risk aversion measure, E (MVP_i) is the expected marginal value product of input i, MFC_i is the marginal factor cost of input i and I_r is the marginal contribution to risk of additional input use. Because risk aversion is measured as a residual, it may include other sources of discrepancy between optimum and actual factor use.

An estimated K related to nitrogen fertilizer use was the dependent variable in a regression analysis with a number of socioeconomic and structural characteristics for a sample of 45 Mexican families. Seven variables explained 37 percent of the variation. Off-farm income, extent of land under control and membership in a solidarity group were all found to have statistically significant negative effects on K or risk aversion. Family size and schooling also had negative effects on risk aversion, but were not statistically significant. Age had a positive coefficient as hypothesized, but was not significant.

The studies reviewed have used different concepts of risk aversion and techniques for estimating risk attitudes. Direct elicitation procedures have produced inconsistent results and Binswanger found the Dillon-Scandizzo

interview technique unreliable and misleading. Very substantial costs are involved in applying the experimental method used by Binswanger and the observed economic behavior approach used by Moscardi and de Janvry may require excessively restrictive assumptions to specify the stochastic influence. Although similar variables have been used to explain estimated risk preferences in the various studies, the results have not been entirely consistent. Some variables have had the expected sign and been significant in some studies, but not in others. In most cases, considerably less than one-half of the variability in risk aversion has been explained by the factors included.

Study Procedures

The risk-income preferences of individual farmers in this study are measured using magnitude estimation (ME). This simple scaling concept (Stevens) is used to determine the importance of a set of goals relative to a base goal. This base goal is preassigned 100 points. The respondent is asked to assign points to each of the other goals such that the scores reflect the importance of each goal relative to the base goal. For example, if a farmer thinks goal B is twice as important as the base goal, then he would give 200 points to goal B. However, if goal B is only half as desirable as the base goal, he would assign only 50 points to goal B. Any number of points can be given to a goal as long as the score reflects the importance of that goal relative to the base goal. Thus ME goal scores, like Pratt coefficients, are comparable across individuals because all respondents have the same point of origin and scale--the base goal and its preassigned weight. The ME values derived will have cardinal properties permitting

scalar transformations.

A random sample of 91 farmers in three Central Indiana counties were interviewed in this study. Information was obtained about the current family and farm situation. Farmers were also asked about their desired future income, expected net worth growth, and anticipated percent debt. For a further discussion of the sample and procedures see Patrick, Whitaker and Blake.

The farmers assigned points to each of eight goals; this procedure was repeated three times using different statements from the goal set as bases. In the first trial, the base statement was "a farm business that produces a stable income" (stable income). In subsequent trials the base statements were "to avoid being unable to meet loan payments and/or avoid foreclosure on my mortgage" (bankruptcy) and "to be recognized as a top farmer in my community" (recognition). The income goal included in the goal set was stated "to attain a desirable level of family living".

Spearman-rho correlations were calculated to check (1) the respondents' scoring consistency and (2) the effect of the base statements on the rank ordering of the goals. The mean correlation for the sample between the trials using base 1 (stable income) and 2 (bankruptcy) was .585; between 1 and 3 (recognition), .605; and between 2 and 3, .685. These results indicate that farmers' goals rankings were more consistent if the bases 2 and 3, rather than base 1, were used for comparisons. Due to its lower repeatability, the ME base 1 results were not used in further analyses. Nine farmers with Spearman-rho coefficients of .4 or less with bases 2 and 3 were eliminated as being too inconsistent for further analysis.

Two measures of risk-income preferences were developed using ME

procedure. The first, a stability-income measure, is the average of the base 2 and 3 points assigned to the goal "a farm business which produces a stable income" when "attain a desirable level of family living" is the index. The second, a bankruptcy-income measure, is the average of points assigned to the goal "avoid being unable to meet loan payments and/or avoid foreclosure on my mortgage" when desirable income is the index. The stability-income measure can be interpreted as approximating the variability of possible outcomes concept of risk and the bankruptcy-income measure is in the safety-first context. Higher values on each measure indicate greater risk aversion. The average values of the stability-income measure and the bankruptcy-income measure are 110.4 and 142.9 respectively. The simple correlation between them is .355.

Empirical Results

The risk-income preferences of farmers are hypothesized to be effected by characteristics of the operator, family situation and farm operation as well as target levels of various goals. Older farmers, those with dependent children, and larger percentages of debt are expected to be more risk averse. Education and factors representing wealth are expected to lead to less risk aversion. The effects of holding an off-farm job and the target levels for future income, percent debt and net worth growth are less clear. Off-farm income may provide some security and lead farmers to be less risk averse but, individuals who are highly averse to risk may seek off-farm jobs for security. Individuals with high target levels for income and net worth may be less risk averse than individuals with lower target levels. Higher planned percent debt may indicate less risk aversion or simply a recognition that borrowing is necessary to achieve other goals.

The estimated coefficients and t values for the stability-income and bankruptcy-income equations with 77 observations are presented in Table 1. Positive coefficients indicate greater risk aversion. Overall, like the previous studies reviewed, the attributes considered in this analysis explain less than one-half of the total variation in risk-income preferences, but a number of variables are statistically significant. Tillable acres farmed, net worth, whether the farm had livestock and average gross farm income had t values of less than .3 in a preliminary version of the equations and were excluded from further analysis.

As farmers become older, it is commonly assumed that they become more risk averse. In the stability-income equation, the age variable had the expected positive sign, but the t value was extremely low. However in the bankruptcy-income equation, age was negative and significant. Many of the older farmers had very few or no debts and the possibility of repayment difficulties or bankruptcy may have been viewed as very remote and assigned a low value. In contrast, many younger farmers had substantial debts or were considering borrowing additional money in the future and possibilities of financial difficulties were of concern.

Education was included as two dummy variables, one for technical education after high school or some college, and a second for college graduation. Both variables were positive in the stability-income equation indicating greater risk aversion by more educated farmers. This was contrary to the hypothesized relationship, but neither coefficient was significant. In the bankruptcy-income equation, college education had the expected negative sign, but was less than one-half the size of the standard error. An alternative formulation with education coded a 1 for high school, 2 for vocational training or some college and 3 for college graduation resulted in positive

Table 1. Estimated Coefficients of Risk-Income Equations, Central Indiana Farmers, 1979.[a/]

Variable	Stability-Income	Bankruptcy-Income
Age (years)	0.1180 (0.2379)	- 1.6638 (1.9553)
Technical education[b/]	7.8791 (0.7401)	0.7300 (0.0400)
College education[c/]	21.8448 (1.5180)	-11.7801 (0.4773)
Children under 18[d/]	-23.2410 (1.7246)	-40.6141 (1.7561)
Percent debt	0.0655 (0.3554)	1.1775 (3.7237)
Off-farm job[e/]	-15.8244 (1.6638)	-30.8419 (1.8895)
Planned future income ($1,000)	- 0.3212 (0.9503)	- 0.9558 (1.6476)
Planned percent debt	0.3243 (1.7401)	0.2128 (0.6652)
Planned net worth growth (percent over 3 years)	0.2426 (1.6728)	0.6469 (2.5990)
Constant	101.7751 (10.3260)	217.0740 (3.9935)
R^2	.2047	.4097
F	1.9155	5.1657

a/ "t" values are indicated in parentheses.

b/ Technical education is coded as 0 for no technical training beyond high school and 1 for technical training or some college.

c/ College education is coded as 0 for college not completed and 1 for college completed.

d/ Children under 18 is coded as 0 for no children, children who have left home, or who are over 18 and 1 if there are children under 18 in the household.

e/ Off-farm job is coded as 0 for no off-farm job and if the farm operator or spouse has an off-farm job as 1.

coefficients in both equations which were smaller than their standard errors.

The presence of children under 18 years of age in the household led to lower levels of risk aversion in both equations. It was hypothesized that households with dependent children would be more risk averse than households without children, but this is not supported by the results. The inter-correlation between age and children under 18 was -.47, but the coefficients changed only slightly with alternative model specifications.

Although the percent debt had only a limited impact on risk aversion in the stability-income equation, it was highly significant in the bankruptcy-income equation. Farmers with a higher percentage of debt were more risk averse as hypothesized.

If either the farmer or spouse had an off-farm job, then the stability-income and bankruptcy-income measures were both significantly reduced. This suggests that operators with off-farm income were less risk averse. However, the results can also be interpreted as indicating that these operators give greater emphasis to a desirable level of family living.

The higher the planned future income, the lower the apparent risk aversion in both equations. These results could be interpreted as indicating greater emphasis on income for a desirable level of living, but if one expects a higher income in the future, there is likely to be less concern with risk.

Planned percent debt and net worth growth have positive coefficients in both risk-income equations. The greater risk aversion of the individuals planning faster growth appears inconsistent with the common view that rapid growth can involve greater risk. However, these individuals could be placing a lower weight on attaining a desirable level of family living in order to achieve their higher rates of net worth growth.

Implications

This study indicates that information on risk-income preferences of farmers comparable across individuals can be obtained through magnitude estimation. The procedure is easier to utilize than the modified-Ramsey approach, does not require the detailed experimental data used by Moscardi and de Janvry, and does not require the resources of the Binswanger's experimental method. Like other interview methods, magnitude estimation is based on the farmer's ability to describe his preferences and goals, but the flexibility of use and relatively low costs are advantages.

This study, like the others reviewed, can explain less than one-half of the variation in risk attributes. Age and education of the operator do not have a strong, consistent effect on risk aversion. Children under 18 in the household, off-farm employment, and higher expected future income reduce both risk-income measures. Actual and planned percent debt and planned net worth increase both risk-income measures. Although the statistical significance differs, the signs of the coefficients are generally the same whether the variability or safety first concept of risk is used. Expected levels of income, net worth growth and percent debt had major roles in explaining risk-income preferences of farmers. Variables of this type should be included in future studies of risk preferences.

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