RISK PREFERENCES OF AGRICULTURAL PRODUCERS:

THEIR USE IN EXTENSION AND RESEARCH

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Introduction

Most models of decision making under risk require knowledge of decision-makers' willingness to bear risk, or equivalently, knowledge of their risk preferences. This is true of both positive applications of risk theory that explain or predict behavior under uncertainty for purposes of policy evaluation and for normative applications which advise decision-makers which decisions they should make given their feelings toward risk.

The specific objectives of this paper are: (1) to review and critically evaluate the current state of knowledge on risk preference measurement methods and empirical results for individual agricultural producers and (2) to suggest directions for future research and extension applications requiring information on risk preferences of individual producers. The implications of aggregate (industry) risk preferences as in risk supply response studies will not be included in this review.

The paper is organized into three major sections: (1) concepts of risk and risk preferences, (2) methods of measurement and empirical evidence on risk preferences, and (3) a review and research recommendations relating to potential uses of individual risk preferences.

Concepts of Risk and Risk Preferences

Definitions of Risk

The behavorial decision model employed determines the appropriate concept of risk in a particular application. The popular Bernoullian expected utility decision criterion, implied by the von Neumann-Morgenstern "axioms of preference," utilizes an objective function that is a function of (potentially) all the statistical moments of the (usually profit) outcome of the risky actions, a_i, i = 1, ..., n, available to the decision maker. In practice, it has been popular among empiricists to assume that the underlying utility function was quadratic or that profits were normally distributed yielding the simpler function of mean and variance only:

$$\underset{i}{\text{Max}}\ (EU)_{a_i} = f(\mu_{a_i}, \sigma_{a_i}^2) \qquad (1)$$

Accepting (1), variance (or a related measure of dispersion such as standard deviation or coefficient of variation) is clearly the appropriate "measure of risk." Aside from the plethora of conceptual and methodological issues concerning whether the variance should be subjective or objective and how it should be elicited or measured (see Anderson, Hardaker, and Dillon), two fundamental potential limitations characterize the "variance as risk" concept embedded in (1). First, if the decision maker is concerned about higher moments of the action-outcome probability distributions, "risk" should be represented by a vector containing variance of profit, skewness of profit, kurtosis of profit, and so on. Inclusion of higher moments in the objective function is a question of empirical significance. Secondly, the convenient scalar measure of risk is based on a utility function considering only the single attribute of profit. Agricultural producers may in fact base their decisions upon such multiple objectives as profits, leisure-work consequences, and personal "aesthetic" considerations. Although there is abundant literature (see Keeney and Raiffa for an excellent recent overview) on decision making with multiple objectives both under certainty and under risk, agricultural economics applications of these models have been rare.

A distinctly different set of risk concepts are implied by the various non-Bernoullian decision models. For example, the "minimax" model would identify the maximum loss of an action, regardless of how remote the probability of its occurrence, as a measure of the riskiness of the action. The lexicographic "safety first" model identifies the probability (α) that random profit (Π) will fall below some critical or "disaster" level (d) as risk, formally:

$$\Pr(\Pi \leq d) = \alpha. \quad (2)$$

Although Bernoullians tend to dismiss all other decision models and their associated concepts of risk as "irrational," based on the violation of the von Neumann-Morgenstern axioms of preference, certain non-Bernoullian models have substantial practical appeal. Analytical usefulness should be the final arbiter of decision models and risk concepts. On this basis, both the Bernoullian and the safety-first approaches have enthusiastic and articulate advocates, for example, Anderson, Dillon, and Hardaker (Bernoullian) and Roumasset (safety-first).

Risk Preference Definitions

Most formal definitions of risk aversion rely on the Bernoullian conclusion that risk preferences can be encoded in a utility function for money (income or wealth) and the associated expected utility function as in (1). Positive marginal utility of income, i.e., $U'(M) > 0$, is commonly assumed for the utility function. Within the framework of Bernoullian decision theory, the following measures yield equivalent risk preference classifications: (i) $U''(M)$, (ii) $-U''(M)/U'(M)$, (iii) $\partial EU/\partial\sigma^2$, (iv) $(d\mu/d\sigma^2)_{EU=constant}$, and (v) the risk premium. A decision maker is classified as risk averse, risk neutral, or risk preferring, respectively, as measures (i) or (iii) are less than, equal to, or greater than zero. For measures (ii), (iv), and (v), the inequalities are reversed to indicate the respective classifications. A Bernoullian utility function is unique only up to a positive linear transformation; the same action will maximize expected utility for $Z = a + bU$, $b > 0$, as for U. In recognition of this property, Pratt developed $-[U''(M)/U'(M)]$ as a unique measure of absolute risk aversion which yields the same value for both Z and U. Pratt also defined $-[U''(M)/U'(M)]M$ as a measure of relative risk aversion. Definition (iii) directly measures the impact of a change in risk (σ^2) on expected utility. Definition (iv), attributable to Magnusson, represents the marginal rate of substitution between risk and expected income.

An intuitively attractive measure of the degree of risk aversion is the amount an individual will willingly pay to avoid participation in a fair bet, or the risk premium. More generally, the risk premium for a risky action is the difference between its expected monetary value and its certainty equivalent. The certainty equivalent of a risky action is the certain outcome that yields an identical level of satisfaction. It should be recalled that regardless of how measured risk aversion is a local characteristic, that is, its sign and degree can vary depending upon the stakes involved.

Methods of Measurement and Empirical Evidence on Risk Preferences

Table 1 summarizes much of the empirical evidence concerning the risk attitudes of agricultural producers that has been assembled over the past 20 years of research. Three measurements methods are represented in Table 1: (1) direct elicitation of utility functions (D.E.U.), (2) experimental methods (E.M.), and (3) observed economic behavior with respect to input demand and output supply (O.E.B.).

Direct Elicitation of Utility Functions

Eight of the studies listed in Table 1 utilized variants of the D.E.U.

Table 1. Empirical Studies of Risk Preferences of Individual Farmers: A Summary

Source	Description of Sample	Method[a]	Sample Size	Percent Distribution of Sample by Risk Classification: Averse	Neutral	Prefer-ring	Mixed[b]
1. Binswanger	Indian farmers and landless laborers	E.M.					
		0.50 real[c]	119	71	0	19[d]	—[e]
		5.00 real[c]	117	84	0	9[d]	—[e]
		50.00 real[c]	118	89	0	2[d]	—[e]
		500.00 hyp.[c]	118	97	0	1[d]	—[e]
2. Conklin, Baquet, and Halter	Oregon orchardists (U.S.A.)	D.E.U.	8	37	0	13	50
3. Dillon and Scandizzo	Brazilian small farmers and sharecroppers	D.E.U.[f]					
		Owners, S.A.[g]	56	70	9	21	—[e]
		Sharecroppers, S.A.[g]	47	58	8	34	—[e]
		Owners, S.R.[g]	56	87	0	13	—[e]
		Sharecroppers, S.R.[g]	47	79	0	21	—[e]
4. Francisco and Anderson	Australian pastoralists	D.E.U.	21	0	0	5	95
5. Halter and Mason	Oregon grass seed growers (U.S.A.)	D.E.U.	44	33[h]	33[h]	33[h]	—[e]
6. Lin, Dean and Moore	Large scale California farmers (U.S.A.)	D.E.U.	6	50	33	0	17
7. McCarthy and Anderson	Australian beef ranchers	D.E.U.	17	48	29	23	0
8. Officer and Halter	Australian wool producers	D.E.U.					
		I, MVM[i]	5	60	20	20	0
		II, MVM[i]	5	40	40	0	20
		I, RAM[i]	5	20	0	60	20
		II, RAM[i]	5	80	0	20	0
9. Webster and Kennedy	Australian sheep and grain farmers	D.E.U.					
		E.F.[j]	5	80	0	0	20
		MVM[j]	5	100	0	0	0
10. Brink and McCarl	Cornbelt farmers (U.S.A.)	O.E.B.	38	66	34	0	—[k]
11. Moscardi and de Janvry	Mexican peasant farmers	O.E.B.	45	100	0	0	—[k]

See next page for footnotes to this table.

Table 1. Description of Empirically Measured Risk Preferences of Individual Farmers from the Literature (continued)

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[a] E.M., D.E.U., and O.E.B. refer to experimental, directly elicited utility, and observed economic behavior methods, respectively.

[b] The risk classification "mixed" includes that portion of the sample having utility functions with both risk averse and risk preferring regions within the relevant range.

[c] Binswanger derived local risk aversion coefficients from gambles with payoff levels of 0.50, 5.00, 50.00, and 500.00 rupees. (The reported daily wage for agricultural workers in the study area was three to six rupees.) Real financial payoffs were made for all but the 500 rupee game which involved hypothetical compensation. Binswanger argued that hypothetical gambles gave reliable results _if_ the respondents had previously participated in the real payoff games. Results presented here are from Table 4 in Binswanger (1978a, p. 17).

[d] Percentages do not sum to 100 because from 2.5 to 10.1 percent of the respondents were classified as "inefficient."

[e] Risk preference classifications were evaluated at a particular point so "mixed" classifications are impossible.

[f] Dillon and Scandizzo used the basic interview approach of the D.E.U. method, but did not actually fit utility functions.

[g] Risk preferences were elicited for owners and sharecroppers separately for two cases: with subsistence assured (S.A.) and with subsistence at risk (S.R.).

[h] Halter and Mason did not present an exact tabulation of risk preference classifications, but reported "that the number falling into each category was about equal."

[i] Officer and Halter derived utility functions for the same sample in two different time periods referred to as Stages I and II which were separated by a year. In Stage I, three models were used: von Neumann-Morgenstern, Modified von Neumann-Morgenstern (I, MVM), and Ramsey (I, RAM); in Stage II only two methods were used: Modified von Neumann-Morgenstern (II, MVM) and Ramsey (II,RAM). The results of the von Neumann-Morgenstern model used in Stage I are not present in Table 2 as this model gave the worst results, and was subsequently dropped from use in Stage II.

[j] Two methods were used: The (E,F)-Approach and Modified von Neumann-Morgenstern (MVM). The (E,F)-Approach elicited the farmer's tradeoff between expected income (E) and focus-loss income (F), where F is the "required minimum income" in the safety first formulation, maximize E subject to $Pr(\Pi \leq F) \leq \alpha$.

[k] "Mixed" classifications were impossible because a constant risk aversion coefficient was assumed by the methodology.

method. Utility functions are derived through interview procedures designed to determine points of indifference between certain outcomes and risky options involving hypothetical gains and losses. After a series of points in U-M space have been identified in the interview, an explicit utility curve can be fitted to the points by regression analysis.

The D.E.U. technique has been criticized as subject to bias arising from different interviewers, preferences for specific probabilities (for example, a 50:50 bet), confounding from extraneous variables, and negative preferences toward gambling (Roumasset; Binswanger, 1978b). Choice of an inappropriate functional form for the utility function can lead to undesirable implications (Lin and Chang). Also, utility associated with the outcome of a particular risky action is probably dependent upon more variables than monetary gains and losses alone. Inability to hold these other variables constant while eliciting single attribute utility functions is likely to lead to substantial imprecision.

In my view, even if the above "technical" sources of bias could be removed by refined interviewing and econometric techniques, the representativeness of choices involving hypothetical gains and losses in a parlor game setting could be questioned. Does a utility function elicited in a short interview around a farmer's living room coffee table reflect his attitudes toward risk in real world decisions? In the latter case, unlike the former, he has much more time to consider a decision, can and often does solicit advice from family members and friends, and is fully aware that he must live with the consequences of his decision.

Although the preceding remarks indicate sources of considerable *a priori* concern, ultimate judgements on the validity of the D.E.U. approach should consider its ability to produce results that are in accord with observed economic behavior. The unique comparative study by Lin, Dean, and Moore evaluated Bernoullian utility, lexicographic utility, and expected profit maximization models. The authors concluded that although the expected profit model was the poorest predicter, "None of the models predicted actual behavior well, with a strong tendency for all models to predict more risky behavior than was in fact observed" (p. 507).

Experimental Methods

Binswanger (1978a) has recently reported on an "experimental method," drawing on psychological research, for measuring risk preferences of more than 350 peasants in rural India. This approach involved use of actual financial compensation at significant levels, was conducted in a series of several visits over five or more weeks which permitted the respondent ample time to reflect on each decision and discuss it with others if desired, and required only a simple choice among eight gambles whose outcomes were determined by a flip of a coin. Impressive efforts were made to teach respondents the nature of the game, to elicit responses reflecting true feelings, to avoid interview bias, and to eliminate other sources of error. Binswanger developed the experimental approach after rejecting the D.E.U. interview method. His field checks on the interview method led him to conclude "...that evidence on risk aversion from pure interviews is unreliable, nonreplicable and misleading, even if one is interested only in a distribution of risk aversion rather than reliable individual measurement" (1978a, p. 45, underlining is Binswanger's).

The realistic experimental approach utilized by Binswanger goes far in remedying some of the more serious measurement flaws of the D.E.U. method. It is less obvious that such games could be funded for realistic levels of gains associated with major farm decisions in the United States. Binswanger spent approximately $2,500 for prize money in his Indian experiment. He estimated a comparable experiment in the U.S. would require $150,000 for prizes alone--an amount he implies is not unreasonable given the cost of many modern research projects (1978b, p. 54).

Observed Input Demand and Output Supply Behavior

The doubts surrounding the validity of directly elicited utility functions have encouraged researchers to seek indirect measures of risk preferences. This approach compares observed economic behavior with respect to factor demand and output supply to behavior predicted by theoretical models incorporating risk and risk preferences. For example, the theoretical model developed by Moscardi and de Janvry from a safety first framework led to the first order conditions:

$$MVP_i^e = P_i/(1 - \Theta K), \quad i = 1, \ldots, n \qquad (3)$$

where MVP_i^e and P_i equal the expected marginal value product and the competitive price of input i, Θ is the coefficient of variation of stochastic yield (output price was assumed constant), and K is the measure of risk aversion, analogous to definition (iv) above. By observing the level of input usage of a particular farmer, inserting that level into an estimated production function, and evaluating the associated MVP_i^e, Moscardi and de Janvry were able to solve for the farmer's K, from (3), as:

$$K = (1/\Theta)\ (1 - P_i/MVP_i^e) \qquad (4)$$

More generally, expected utility maximization under risk leads to first order conditions of the form (Magnusson, p. 65; Anderson, Dillon, and Hardaker, p. 163):

$$E(MVP_i) = MFC_i + R_a I_r, \qquad i = 1, \ldots, n \qquad (5)$$

where $E(MVP_i)$ is expected marginal value product of input i, MFC_i is nonstochastic marginal factor cost of input i, and R_aI_r is a "risk adjustment." R_a is the entrepreneur's local risk aversion coefficient as described by definition (iv) above and I_r is the marginal contribution to risk of additional input use. Assuming I_r is positive, risk aversion ($R_a > 0$) implies a positive "risk adjustment"; i.e., a risk averse expected utility maximizing entrepreneur will "stop short" of equating E(MVP) to MFC.

Equation (5) suggests a theoretical approach for solving for R_a in terms of empirically observable magnitudes:

$$R_a = [E(MVP_i) - MFC_i]/I_r \tag{6}$$

In practice, however, obtaining appropriate estimates of I_r can be difficult without invoking excessively restrictive assumptions on the sources and functional specification of stochastic influences. Pope has proposed an econometric approach, based on the O.E.B. concept, that provides estimates of an assumed constant risk aversion coefficient under certain assumptions.

On the supply side, Brink and McCarl derived indirect estimates of risk aversion coefficients of 38 large Cornbelt farmers by comparing their elicited cropping plans to those predicted by a variant of Hazell's MOTAD linear programming model. The value of the parametrically varied risk aversion coefficient that minimized the difference between the model's predicted plan and the farmer's actual plan was selected to represent the farmer's risk preferences.

The O.E.B. approach shares with the D.E.U. method the advantage of furnishing measures of risk aversion that can be incorporated directly into models of economic decision making under risk. In addition, however, the O.E.B. approach escapes the compelling criticism that the revealed risk preferences may not be germane to real world decisions. Unfortunately, the O.E.B. method is vulnerable to serious errors of inference. Because it measures risk preferences on the basis of the difference between actual factor use or output supply levels and the levels associated with the (risk neutral) expected profit maximizing solution, it attributes the entire difference to risk aversion. In actual fact, many other explanations such as inaccurate or incomplete technical and market information, different resource endowments, capital constraints, different objective functions, and different subjective probability assessments could underlie some or all of the residual attributed to risk aversion.

Empirical Findings on Individual Producer Risk Preferences

In assessing the empirical evidence in Table 1 it is important to consider the quality of the samples represented. Overall, risk preferences have been elicited for a very small total number of agricultural producers. Furthermore, there was no attempt in most studies to achieve industry representativeness in sample selection. These sample limitations, combined with previously cited measurement problems, make generalizations from the evidence in Table 1 to the general populations extremely tenuous.

One tentative conclusion is that farmers in less developed countries appear to be more uniformly risk averse than their wealthier counterparts in developed countries. Among the studies of Australian and American farmers, approximately 50 percent of the sampled individuals manifested risk preferring attitudes over at least some ranges when the measurement technique did not preclude this possibility. Risk neutral or risk preferring attitudes over some ranges among a significant fraction of agricultural producers in developed countries cannot be excluded on the basis of the available evidence. The greater incidence of risk aversion in developing countries is consistent with the widely accepted hypothesis of decreasing absolute risk aversion with respect to wealth.

Only the studies by Moscardi and de Janvry, Dillon and Scandizzo, Binswanger, and Halter and Mason, among those reviewed, focused explicitly on the relationship between producer attributes and risk preferences. Overall, few consistent relationships emerged over all four studies. The one exception was a positive correlation between education and the willingness to bear risk. Given the vast differences between the peasant settings of three of these studies and modern commercial agriculture, generalizing the results to farmers in developed countries is probably not possible.

Potential Uses of Producer Risk Preferences: Review and Research Recommendations

To recommend directions for future research on risk preferences, it is necessary to ask why it is important to know producer risk preferences in the first place? Recognizing the added cost of measuring risk preferences and the unproven reliability of the measures, it is necessary to evaluate within the context of the specific problem whether attempted measurement is worthwhile. For many problems, some alternative approach may be more appropriate. Implications for future research are discussed below under three important areas of potential application.

Farm Management Extension Applications

The desire to tailor extension farm management recommendations to the current risk preferences of particular farmers provides one potential justification for measuring individual risk preferences. Although this application is recommended by some advocates (Makeham, Halter, and Dillon), time, cost, and practical problems associated with direct elicitation of utility functions are likely to limit their use in extension programs. Even if researchers were to hand an extension worker an elaborate set of equations relating risk aversion at all relevant loss and gain levels to personal and business attributes for farmers in his district, the personal and evolutionary nature of attitudes toward risk would probably prevent their confident application to specific individuals. There likely exists considerable heterogeneity in risk preference among individuals with superficially common business and personal characteristics (recall evidence in Table 1). Furthermore, evidence from psychological studies suggests that the behavioral predictive power of an individual's willingness to bear monetary risk is likely to change from situation to situation given the multiobjective nature of most decisions (Schneider, pp. 390-96). Changing objectives, information, and attitudes could make an individual's risk aversion coefficient an elusive moving target.[1] Neither farmers nor field extension personnel are likely to consent to obtaining personal updatings of utility functions or safety first margins every time a new recommendation is given.

In light of the above discussion, what should extension specialists and researchers interested in developing materials and models with extension applications do to incorporate risk considerations? Some specific recommendations which do not require elicitation of individual risk preferences are:

(a) Extension specialists should provide more and better information on alternative decision options and their objective outcome probabilities. They also should devote more effort to teaching principles of decision making and information utilization as exemplified by the excellent recent national SEA-Extension project, "Dealing With Risk In Farm Decision Making."

(b) Researchers constructing normative decision models for use by farmers should use risk aversion indices that are sufficiently simple and intuitive that they can be supplied by the farmer himself. Alternatively, these models might incorporate decision rules that depend upon objectively measurable financial ability to bear risk. Hardin and Walker, for example, required that a farmer exceed a minimum equity ratio in order to assume the risk of borrowing in a land investment analysis.

(c) Researchers can rank decision options on the basis of rules of stochastic dominance. Meyer's criterion for identifying risk efficient decisions for decision makers whose risk aversion functions fall between certain bounds is a promising method for certain prescriptive models (Robison and King).

Technology Transfer and Rural Development Applications

Estimating single-attribute risk aversion coefficients of peasant farmers and relating them to socioeconomic variables as in Moscardi and de Janvry is probably not the most efficient method of predicting their willingness to adopt new technology or participate in rural development programs. If technology adoption or development program participation is of primary concern, it seems appropriate to use these phenomena as dependent variables directly, and to include all relevant factors as independent variables. A review by Havens of variables commonly used in technology adoption studies listed: (1) size of operation, (2) education, (3) social status, (4) contact with information, and (5) social participation. Other variables such as age, local group identification, opinion leadership, management practices, and attitude toward credit have also been used but less frequently.

Microeconomic Policy and Predictive Applications

It has been argued that farm management extension and development program planning applications generally do not justify measurement of individual risk preferences, or at least not formal measures based on directly elicited utility functions. In the area of microeconomic policy and predictive applications, however, such measures frequently are justified. The studies by Baquet, Halter, and Conklin; Harris and Nehring; and Lin, Carman, Moore, and Dean (LCM & D) provide examples of such microeconomic policy and predictive applications. Baquet et al. incorporated producer risk preferences in an attempt to compute the value of publicly supplied weather forecast information to southern Oregon orchardists. Harris and Nehring incorporated the degree of risk aversion into a theoretical model for determining the maximum bid price for an acre of land by farmers in different farm size classes; they assumed absolute risk aversion to be the same for all farmers in a given size class. LCM & D examined how individual risk preferences could influence the impact of income tax provisions on output and risk taking behavior.

For studies in this category, knowledge of the "typical" risk preferences characterizing a particular class of farmers, rather than those of individual farmers, are often needed to generalize the policy implications of the results. This is an important distinction since it is not at all certain that risk preferences within such classes are the same.

Three important questions concerning incorporation of risk preferences in microeconomic policy and predictive studies are addressed below.

1. Sensitivity to risk preferences

The sensitivity issue requires assessing whether deviations from risk neutrality (expected profit maximization) are likely to have much impact on the results; in the studies by LCM & D and Harris and Nehring, it was rather conclusively shown that they will. In general, however, there is no easy answer to the question of whether the added precision or policy relevance, if any, of incorporating risk preferences in such studies is worth the cost. The danger is that the difficulty or cost of eliciting utility functions for more than a small, possibly unrepresentative, sample of farmers will reduce the studies to methodological excursions rather than practical policy evaluation tools. This danger seems to have been realized, at least in part, in both the Baquet et al. and Harris and Nehring studies as reflected in the extensive qualifications of their results (see Baquet et al., p. 519, and Harris and Nehring, p. 166). Researchers must seriously ask themselves, especially for applications where results are not highly sensitive to risk preferences, whether ignoring risk preferences will increase their chances of developing quantitative results for a larger and more representative sample of the population so that their conclusions will be of practical value to policy makers.

2. Relationships between producer attributes and risk preferences

Empirical research on two groups of hypotheses is crucial to examining the important, but much neglected, dynamic structural and distributive implications of income instability in agriculture and of public policies to mitigate such instability. The first group includes the relationship between risk preferences and structural features, especially farm size and legal form of ownership. For example, are larger or corporate farmers generally less risk averse than small or family farmers who are sole proprietors? The second, not unrelated, group of hypotheses involves examining the frequently assumed positive relationship between accounting measures of financial ability to bear risk and willingness to bear risk.

A related research priority is the need to examine the differential historical capacity of farms of different sizes and types to survive and to maintain profitability under price and yield instability. Studies by Lin and Ingerson; Anderson; and Moore provide tentative evidence that small farms may benefit relatively from increased income stability, but much more empirical work is needed in this area.

3. Methodological options

Which methodologies appear most fruitful for measuring risk preferences for use in microeconomic policy and predictive applications? If the problem strictly requires risk preferences of individual producers rather than "typical" preferences of designated classes of producers, the experimental method as utilized by Binswanger seems most likely to provide reliable replicable measures of risk aversion, assuming the method is adequately funded and conscientiously executed. If particular care is taken to frame the questions in a realistic decision context and to avoid other sources of bias, the D.E.U. method offers a possible lower cost alternative.

In applications where objectives other than profit alone are likely to be important, serious consideration should be given to utilizing a multi-objective decision model. In certain cases, a certainty multi-objective approach may be preferable to a single-attribute risk model.

If average risk preferences of designated classes of farmers are required, two methodological options are available. The first approach is typically carried out in two stages: (a) estimate risk aversion coefficients for a large sample of individuals whose members vary according to the class attributes of interest, and (b) describe the relationship between risk aversion level and personal or business attributes. Regression analysis and multivariate statistical techniques are statistical tools which can be used to describe these relationships (Binswanger, 1978a; Dillon and Scandizzo; Moscardi and de Janvry; and Halter and Mason).

The second (O.E.B.) approach would be to estimate aggregate risk aversion coefficients or risk responses of designated classes of farmers directly with econometric or risk programming models. The econometric approach associated with risk supply response models could be applied to selected subsamples of the population; that is, separate equations could be calculated for small farms, large farms, or other classes of interest to obtain a measure of differential risk response. The problem under study could determine the dependent variable of interest such as acreage planted, bid prices for factors or products, or frequency of utilization of selected strategies. Carlson, for example, included a risk variable in an equation to explain the market price of semen from different dairy sires. His results revealed a negative coefficient on the risk variable indicating that dairymen in his sample imputed a "risk discount," on the average, to semen from young and unproven, and thereby more risky, bulls.

Risk response models which bypass the direct estimation of formal risk aversion coefficients to focus directly on the measured impact of risk on the variable of interest should be seriously considered whenever their estimation is feasible. Data availability is likely to pose the greatest constraint to the use of this method. Aggregate time series data are unlikely to be available, for example, to estimate separate risk-response acreage supply functions for small and large farmers.

Footnotes

Douglas Young is an Assistant Professor and Assistant Agricultural Economist at the Department of Agricultural Economics, Washington State University. This is Washington College of Agriculture Research Center Scientific Paper No. 5395. This paper draws on two more detailed papers on this topic (Young and Findeis; Young et al., 1979) stemming from the author's involvement on Western Regional Research Project, W-149. Helpful suggestions from several fellow W-149 project participants on earlier versions of this paper are gratefully acknowledged.

1 An alternative hypothesis is that risk preferences are relatively stable over time, but that changing behavior under risk is due to varying constraints and changing subjective assessments of expected values and variances. The area of expectation formation processes requires more research to satisfactorily resolve this question.

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