Pub King

Risk Modeling in Agriculture: Retrospective and Prospective

Program proceedings for the annual meeting of the Technical Committee of S-232, held March 24-26, 1994, Gulf Shores State Park, Alabama.

Iowa State University
Ames, Iowa 50011-1070
August 1994

RISK RESEARCH AND PRODUCER DECISION MAKING: PROGRESS AND CHALLENGES

George F. Patrick*

As the S-232 project draws to a close, it is appropriate to briefly review the progress and challenges in the application of risk research to producer decision making. Although none of the three "risk projects" have had improved producer decision making as an explicit objective, it was implicit and has been a significant part of the activities of many of the personnel involved with the projects. This paper is divided into two major sections. The first briefly discusses three reviews of risk management in farm management with an emphasis on the evolution of risk management computer software. The second section addresses some of the challenges faced in making risk research and extension efforts more relevant for producers' decision making.

Progress in Risk Applications for Producers

Almost concurrently with the organization and implementation of the initial risk project, W-149, Walker and Nelson (1977) developed an "interpretive review" of 215 applied and illustrative empirical studies of agricultural decision making under uncertainty. They concluded that "overall, very little evidence was found of significant efforts in either classroom teaching or extension to apply the concepts of decision making under uncertainty to farm management." During the late 1970's, there was considerable interaction between W-149 and the SEA-Extension project, "Dealing with Risk in Making Farm Decisions." Researchers from W-149 participated in a national extension workshop on risk management in 1978. Walker and Nelson (1980) addressed a W-149 meeting noting the gap between theory and practice in risky decision making. They also note that "the [W-149] project has not yet shown an emphasis on developing computerized, on line, flexible, and general tools for ready use in the field utilizing the data developed and the concepts and models appropriate to decision making under uncertainty."

During the S-180 project, Knight et al. (1987) reported that "concepts and procedures for decision making under uncertainty still have not been fully incorporated into extension programs and decision aids." They reviewed two whole farm planning models (Whole Farm Risk-Rating and ARMS) in which outcomes were a function of several interrelated random variables, the parameters of which could be specified by the decision maker. They also reviewed the VPI crop insurance evaluation model which allowed yield variability but not price variability. The fourth model reviewed, the Commodity Program Analyzer, was designed to evaluate government program participation. In his discussion of Knight et al., McGuckin (1987) asked whether such computer programs were intended for a) management assistance by presenting consequences of alternative choices, or b) educational experience with the methodology for risk management. Given the data requirements of these models and the difficulties of obtaining accurate information from farmers, McGuckin questioned their general usefulness in actual decision making. As an alternative, he suggested decomposition of complex problems into interrelated spreadsheet scenarios through which the "user may come to more fully appreciate the concept of risk given complicated interactions that occur on a farm."

*Professor, Department of Agricultural Economics, Purdue University.

The personal computer revolution of the late 1980's led to a rapid expansion in the development of computerized farm management tools. DeVuyst et al. (1994) suggest that these tools can be divided into three categories. The first, decision analysis, assumes decision makers can be modeled as if they maximize expected utility where utility is a function of uncertain wealth. Thus, with the appropriate assumptions, the decision maker's exact optimal choice of investment opportunities can be determined. Decision analysis is most common in a research environment and has seen very significant progress since the beginning of the W-149 project. The second category, risk analysis, uses a variety of tools to provide information about the distribution of outcomes associated with a number of specific alternatives considered. Hopefully, producers will use this information to make "better" decisions. Again, significant progress has been made in this area with what was decision analysis in a research environment often becoming risk analysis in an extension setting. The third category of farm management tools, computerized decision aids, may be partial or whole farm in nature. Typically these tools provide only point estimates, although limited sensitivity analyses may be provided automatically. Generally these models do not provide an estimate of the probability of various outcomes.

There is clearly more awareness of and efforts to apply the concepts of decision making under uncertainly now than in the mid-1970's. Many computerized farm management tools have been developed by agricultural economists, and some are even being used. However, use of risk management software tools by extension personnel and producers is not common. FINPACK, arguably the most widely used software package in farm financial management, has very limited capabilities of considering risk. Although considerable progress has been made in risk related research, improvements in its application to producer decision making have lagged. As a result, the gap between the theory and practice of decision making under risk appears even wider than it was in the mid-1970s.

Challenges in Improving Producer Decision Making Under Risk

There are a number of challenges which we face in attempting to narrow the gap between the theory and practice. I will focus on several different areas but they are by no means exhaustive.

Nearly 25 years ago, Chandler et al. stressed clarity, speed, and reliability as essentials of computer software which is to be used by farmers. They make a convincing case that software intended for extension purposes must have characteristics very different from software used for research purposes. The recent success of WINDOWS as compared to DOS provides on-going support for their argument. I would add timeliness and relevance to the Candler et al. list of factors which are critical for software useful to producers. However, based on limited personal experience and observation, final computer software development and consumer delivery does not play to the strength and comparative advantage of most agricultural economists or universities. This is a significant challenge which may require substantial resources, or ingenuity, to overcome.

Traditionally, decision making has been viewed as a process by agricultural economists (Johnson et al. 1962). However, as researchers, we tend to view decision making as an act and have emphasized various quantitative methods to improve the selection of an alternative.

Farmers often view the decision process as learning process. They may start with a very fuzzy, indefinite view of expected outcomes and attempt to refine that view. Ortmann et al. (1993) found that large-scale farmers rated nine of seventeen sources of information above 3.0 on a five-point Likert-type scale in terms of importance in production decision making. In contrast, only three sources rated above 3.0 for marketing and financial decisions, and ratings of information sources were generally lower for these decisions. As farmers learn, they may re-evaluate their situation and when it becomes clear that one alternative tends to dominate the others, the decision is made. Provision of historical and forecast data by researchers to the producer can play a critical role in this process. Ortmann et al. (1992) found the information that farmers required for risk management was largely concerned with defining expected outcome. Only in the marketing and finance areas was there interest in the tools of risk management. Clearly we in research and extension have a role in providing producers with more complete, and more useable, information about possible outcomes.

We, as researchers, have been concerned with the sources of risk and/or variability in agriculture. Although we have identified a number of different sources of risk, there are relatively few stochastic variables. Perhaps we are making things too difficult for ourselves and producers! Most sources of risk impact on the prices of commodities, costs of inputs, or the physical yields. Other sources of risk, such as those associated with the family (health and injury concerns, changes in family relations, etc.) are difficult to incorporate into our models but could be included on the cost side. However, farm families seem to take these in stride and move on. Our attention, and that of producers, needs to focus on the important stochastic variables.

As researchers, we have often been concerned with producers' management responses to risk in isolation. Producers do combine production, marketing, and financial responses to risk, and they do it in much more complex ways than are included in our models. When we combine production and marketing responses, production and financial responses, or other possible combinations in our research we tend to pat ourselves on the back. However, even when we combine responses, we consider only a small subset of the possible responses available to producers. Have we neglected accuracy in representing the problem for the precision of the numerical results from our research? What are the implications of this approach to the relevance of our results for producer decision making?

During the risk projects, alternative decision models have been explored as explanations of farmer behavior and for predictive purposes. How do producers define "risk" in relation to their farm operations? The responses of 59 participants in the 1993 Top Farmer Crop Workshop are summarized in Table 1. I developed the categories and initial classification and they were verified by Wes Musser. Other individuals would probably develop other classifications and descriptions. However, it appears that producers do reflect a variety of different concerns in their definitions of risk. Table 1 suggests that farmers have concerns other than maximizing expected utility, especially if utility is defined as solely a function of wealth, when considering risk.

Table 1. Classifications of Risk Definitions of 1993 Top Farmer Crop Workshop Participants.

Definition of Risk	Number
Possibility of loss or shortfall in results	11
Variability/uncertainty	10
Lack of control (weather, markets, etc.)	9
Risk-return trade-off	6
Exposure	5
Probability related statement	4
Magnitude/size of risk statement	4
Positive challenge/opportunity	3
Other	7
TOTAL	59

Dawes argues, "when we are faced with an important choice, the idea that thinking per se is a flawed and limited process is an unpleasant one." Our limited success in empirical elicitation, especially of utility functions and joint probability distributions, becomes a strong argument for use of the expected utility model. With data developed for producers' use, the expected utility model is powerful, especially for normative purposes. Often, as a practical matter, multidimensional aspects may enter planning models as feasibility constraints. We can use our models and data to provide farmers with information for improved decision making but this has generally not been the focus of our research.

Farmers are often not concerned with the "best" decision in an abstract situation such as is typically assumed in research. This was brought home to me several years ago after a graduate student had determined optimal production-marketing strategies for a Central Indiana corn-soybean producer. In making a late winter presentation to a group of farmers the first question was something like "How does the $2.35 December corn and $6.75 November soybeans futures prices affect this?" The producer had recognized that prices favored soybeans rather than corn for that particular year and the optimal decision was not the best decision for that specific year. All too often we fail to recognize the importance of additional information in a specific decision situation.

Risk is pervasive and producers deal with it on a daily basis. Information is valuable and has a cost associated with it. Producers are unwilling to pay more than the information is

perceived to be worth. This affects educational programs to develop decision making skills of producers as well as decision making. The explicit incorporation of risk and uncertainty into a model introduces considerable additional complications and costs. In working with producers, it is critical to identify those decisions in which risk is really important and focus on these decisions. As McGuckin noted, it is also important to define what we are attempting to accomplish with producers.

In conclusion, substantial resources have been devoted to risk related research. Progress has been made. From a relatively specialized field, the situation has changed so that "everybody is doing risk." Far fewer resources have been devoted to making risk research and concepts of decision making under risk accessible to producers. It has not been the priority in extension that it has been in research. Cooperative efforts, such as those suggested by Walker and Nelson (1980), between research and extension would be productive.

References

Candler, W., M. Boehlje, and R. Saathoff. 1970. "Computer Software for Farm Management Extension." *American Journal of Agricultural Economics* 52: 71-80.

Dawes, R. M. 1988. *Rational Choice in an Uncertain World.* Harcourt Brace Jovanovich, San Diego.

DeVuyst, E. A., G. F. Patrick, and G. F. Ortmann. 1994. "A Review of Risk Management Software." Purdue University, Department of Agricultural Economics Staff Paper (in draft).

Johnson, G. R., A. N. Halter, H. M. Jensen, and D. W. Thomas (eds.). 1962. *A Study of the Managerial Processes of Midwestern Farmers.* Iowa State University Press, Ames.

Knight, T. O., K. A. Kubiak, and B. A. McCarl. 1987. "Incorporating Uncertainty in Extension Decision Aids: An Overview of Four Approaches." *Future Directions in Risk Analysis for Agricultural Production Firms.* Proceedings of a S-180 Seminar: "An Economic Analysis of Risk Management Strategies for Agricultural Production Firms," San Antonio, Texas, March 22-25, 1987, Department of Agricultural and Applied Economics, University of Minnesota.

McGuckin, J. T. 1987. "Mechanism for Extending Management Tools: Discussion." *Future Directions in Risk Analysis for Agricultural Production Firms.* Proceedings of a S-180 Seminar: "An Economic Analysis of Risk Management Strategies for Agricultural Production Firms," San Antonio, Texas, March 22-25, 1987, Department of Agricultural and Applied Economics, University of Minnesota.

Ortmann, G. F., G. F. Patrick, W. N. Musser, and D. H. Doster. 1992. *Information Sources, Computer Use, and Risk Management: Evidence from Leading Commercial Cornbelt Farmers.* Purdue University Agricultural Experiment Station Bulletin No. 638.

Ortmann, G. F., G. F. Patrick, W. N. Musser, and D. H. Doster. 1993. "Use of Private Consultants and Other Sources of Information by Large Cornbelt Farmers." *Agribusiness: An International Journal* 9: 391-402.

Walker, O. L., and A. G. Nelson. 1977. *Agricultural Research and Education Related to Decision Making Under Uncertainty: An Interpretive Review of Literature.* Oklahoma State University Agricultural Experiment Station Report P-747.

Walker, O. L., and A. G. Nelson. 1980. "Dealing with Risks in the Management of Agricultural Farms: An Extension/Teaching Viewpoint." *Risk Analysis in Agriculture: Research and Educational Developments.* Proceedings of a W-149 Seminar: "An Economic Evaluation of Managing Market Risk in Agriculture," Tucson, Arizona, January 16-18, 1980, Department of Agricultural Economics, University of Illinois, AE-4492.