STAFF PAPER

A COMPARISON OF RISK PREFERENCE MEASUREMENTS WITH IMPLICATIONS FOR EXTENSION PROGRAMMING

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*Professor and Associate Professor, Department of Agricultural Economics; Research Associate, Department of Grain Science and Industry, Kansas State University, Manhattan, Kansas 66506-4011.

KSU
KANSAS STATE UNIVERSITY

Department of Agricultural Economics
Kansas State University, Manhattan, Kansas 66506

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by

Bryan W. Schurle and William I. Tierney, Jr.

Professor and Associate Professor, Department of Agricultural Economics, Kansas State University, Manhattan, Kansas 66506-4011.

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INTRODUCTION

Farm management researchers and extension specialists have begun to question some of the basic premises that agricultural economists use when modeling decision making at the firm level (Levins, 1989). Mathematics, rather than psychology seems to be the preferred discipline when analyzing human behavior, particularly managerial behavior under conditions of uncertainty. The conventional wisdom supporting this choice is the belief that mathematics bestows "rigor", "simplicity", and even "elegance" to the analysis. Mathematics presumably allows economists to more precisely model managerial decision making. The fact that farmers may not actually solve the excruciatingly complex calculus equations that are prominently featured in many of the professions' leading journal articles is irrelevant as long as farmers merely act "as if" they solved those equations.

Take, for example, farmers' attitudes towards risk. Many of today's applied farm research projects depend, to a large degree, on the researcher's assumptions regarding farmer's risk attitudes. When faced with uncertainty, a farmer's decisions are assumed to be governed as if s/he were maximizing a utility function given a set of income alternatives. The alternative that is eventually selected is assumed to be uniquely conditioned by his/her own risk preferences. Stochastic dominance techniques, among others, make specific assumptions about farmers' risk aversion levels. Based on these assumptions, the technique's algorithm will eliminate from consideration those income/loss generating alternatives that are not "optimal" for the assumed level of risk aversion. But exactly what are farmers attitudes towards risk, how do we measure risk, and are there any alternative risk measurement techniques that we can use for cross comparisons?

Extension marketing specialists often have difficulty "explaining" the behavior of farmers who are faced with commodity price risk. Patrick et al. (1985) surveyed crop and livestock producers to determine their risk perceptions and their management responses to risk. Commodity price risk was the greatest risk identified by both producer groups; however, farmers' management of price risk was amazingly deficient. Out of 22 management responses to risk, forward contracting was ranked 10th in order of importance and hedging with futures was ranked 2nd from last.

Commodity marketing alternatives using forward pricing strategies have been available to agricultural producers for decades. Despite producers' risk perceptions, the huge majority of the crops and livestock marketed by farmers are priced on date of delivery. Several studies have documented that producers' use of forward pricing strategies is limited. This is particularly true for strategies involving futures and options contracts (U.S. General Accounting Office, 1988; Smith, 1989).

Congress is aware of and concerned about the apparent inability of producers to manage commodity price risk. The Food Security Act of 1985 authorized the USDA to implement a pilot program to provide producers of program crops with training and incentives to use futures and options for hedging purposes. The results of the program were mixed. An evaluation of the program found that the participants did not fit the profile of the "average" U.S. producer. Compared to the "average" farmer, the pilot program participants had more education, were younger, had larger farm operations, and were more knowledgeable about futures and options. Despite their unique characteristics and the specialized training they received, only a small number of the participants used forward pricing strategies during the 3-year period, 1986-1988 (Makus et al. 1989).

Crop insurance is another risk management strategy that is frequently emphasized in extension programming, but may be underutilized. Except for the last 2 years (when crop insurance was a mandatory provision for eligibility for some drought disaster payments), farmers' participation has been much lower than policy makers would have preferred. Extension programming in both marketing and farm management seems to be built on the assumption that producers are risk averse, rational, and capable of dispassionate analysis and implementation of appropriate risk management practices. Extension workers need to know the range of risk preferences in their audience and how these preferences may influence producers' choice of alternative risk management practices.

One of the more commonly used instruments to measure risk attitudes is a method developed by Meyer (1977). He formulated a set of criteria for generalized stochastic dominance using the Pratt-Arrow absolute risk aversion coefficient as a base and specifying both upper and lower bounds. A researcher using Meyer's technique could elicit risk aversion intervals from a particular decision maker. Past studies of farmer's risk aversion using Meyer's technique have generally been performed on relatively small populations and often were done without alternative tests that might have "validated" the Meyer's test scores (Wilson and Eidman, 1983). Risk aversion scores generally have not been correlated with age or income nor compared to farmers' own perceived and self-articulated risk attitudes (Thomas, 1987).

Agricultural economists should question whether it is appropriate to place so much reliance on assumptions regarding risk preference of producers or on complex mathematical instruments to measure risk aversion. Both research work and extension programming depend to a large degree on risk preferences of producers. Therefore, the purpose of this paper is to report on an application of a Meyer's-type risk measurement test to a large farm population. This paper will investigate whether these results are consistent with alternative risk measurement techniques. In addition, this paper will explore relationships between risk aversion and other farm or farmer characteristics. Finally, this paper will discuss possible implications of risk preferences for extension programming.

METHODOLOGY

Survey Population. The authors are interested in the risk attitudes of Kansas commercial farm operators. One of the difficulties associated with attitudinal research is collecting data. Attitudinal choices rarely can be observed indirectly

or inferred from second-hand data. Generally, you have to ask people and record their responses. Besides the problems of designing a valid and unbiased survey instrument, there is the problem of collecting a sufficiently large sample from a population with characteristics similar to the theoretical population that you would like to study.

Commercial farms are generally considered to be those operations that are large enough to support a family. In 1987, the average ratio of Kansas farm expenses to gross farm income was 77 percent. This figure is based on data drawn from 480 farms that were members of the Kansas Farm Management Association (KFRMA). Average farm family living cash expenses for KFRMA families was $18,595. Based on a .77 ratio of expenses to income, we estimate that a "typical commercial farm" in Kansas would need sales in excess of $81,000. Most of the farms in the sample for our survey meet the sales criterion for being "commercial" farms (Table 1). Nearly 60 percent of our survey respondents had sales exceeding $100,000 in 1988.

Table 1. Value of Total 1988 Farm Production for Survey Respondents

Category	Number of Farms	Percent of All Respondents
Less than $10,000	4	4
$10,001 - $25,000	7	6
$25,001 - $50,000	13	12
$50,001 - $100,000	21	19
$100,001 - $150,000	30	27
$150,001 - $250,000	22	20
$250,001 - $400,000	10	9
$400,000 +	3	3

In order to focus our efforts on the "commercial" segment of the farm population, we had to use a modified stratified sampling technique. Most of the questionnaires were distributed and filled out at county level extension meetings. The farmers attending these meetings were members of Producer Marketing Clubs. Each club consists of farmers and ranchers who meet regularly to learn more about commodity marketing techniques, to analyze and discuss market developments, and to vote on and execute small purchases or sales of commodity futures and options. This is one way for farmers to observe the consequences of various marketing strategies. A small number of completed questionnaires were also received from the families of students who were taking marketing and farm management courses at Kansas State University.

Most of the survey respondents had both crop and livestock enterprises. Two-thirds of all the respondents had livestock, but only 31 percent reported that livestock sales accounted for more than half of their total farm sales. The average acreage planted to crops was 875 acres. The most typical livestock enterprise was cattle herd with an average size of 76 head.

Survey Instruments. Three different instruments were employed to measure the risk attitudes of Kansas commercial farmers. These were a financial-risk test, a risk-aversion interval classification system, and a self-ranking question on risk preference.

Economists recently have begun to look outside their discipline in the search for other behavioral paradigms that might better explain the choices made by firm managers. Managerial science and psychology may offer some useful models that agricultural economists may be able to adapt for their studies of farm decision making in a stochastic environment. One method to measure a farmer's risk preferences is an instrument designed by Farley (1988). He is a psychologist at the University of Wisconsin who has done extensive work in the area of individual's attitudes towards financial risk. He constructed one test, in particular, for a farm population. This test consists of 20 true-false questions for which the subject receives one point for each response, indicating a preference for a risky situation. Farley had tentatively identified a score of 17 or higher as suggesting financial risk-taking potential.

The risk-aversion interval classification instrument used in our research is similar in design to questionnaires described by King and Robinson (1981) and Thomas (1987). A series of questions is posed to the respondent concerning which of two income distributions s/he prefers. Each distribution contains six randomly generated income levels. The respondent is asked to choose one or the other, and then, based on that choice, s/he is directed to a specific second, then a third set of questions offering other choices of income distributions. The responses will generate one of eight possible risk-aversion coefficients, which represents the degree of concavity or convexity at a specified point on the respondent's utility function. These discrete coefficients range in value from -.0005 (extremely risk loving) to .005 (extremely risk averse). Some studies have used different risk aversion intervals whose range is restricted to risk neutral to risk averse (Cochran and Raskin – 1986). Empirical tests of these instruments have been limited to small samples. King and Robinson tested their instrument on 17 farmers who attended extension workshops. Thomas' population was limited to some 30 farmers residing in northeastern Kansas, while Wilson worked with a group of 47 farmers.

The third instrument used to measure risk preferences was a self-ranking question. Respondents were asked to rank their personal preference for taking risks. A 9-point scale was provided with 1 presenting extreme dislike, 5 – neutral, and 9 signifying a high preference for taking risks. Thomas used a similar question in conjunction with a risk-aversion interval instrument.

Experimental Format. These three instruments were included as part of a broader questionnaire on farmer's attitudes, perceptions, and management responses to uncertainty. Most of the completed questionnaires were received from farmers who were attending extension marketing workshops because farmers often fail to complete mail surveys. The extension workshops provided an opportunity to explain the purpose of the survey, to provide time for the farmers to immediately complete the questions, and to monitor the process in the hopes of minimizing errors.

The surveys were anonymous. Respondents were asked only for their county and local zip code. Considerable care was used in explaining the risk preference instruments, but a significant number (about 20 percent) did not correctly follow the instructions for the risk-aversion interval test. No "coaching" or clues were provided as to how to decipher the risk-interval test, though, on several occasions, some respondents were observed to be using calculators to estimate an average

FIGURE I. DISTRIBUTION OF SCORES ON THE FARLEY TEST OF INDIVIDUALS ATTITUDES TOWARD FINANCIAL RISK

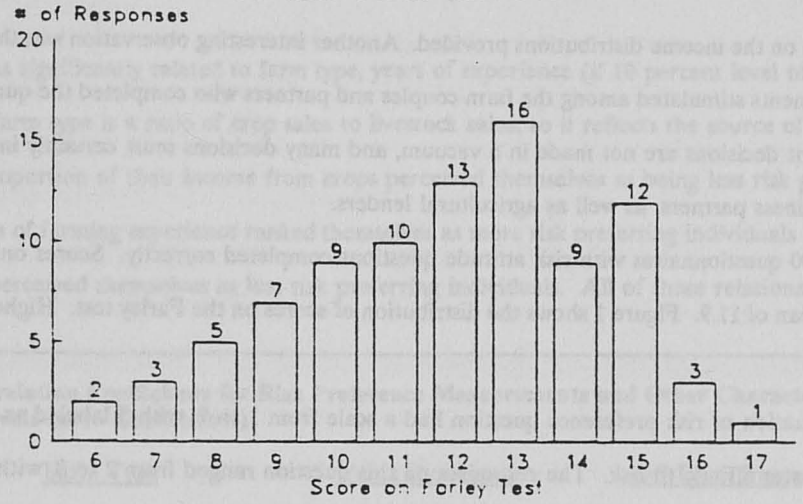


FIGURE II. DISTRIBUTION OF SCORES ON SELF RANKING QUESTION

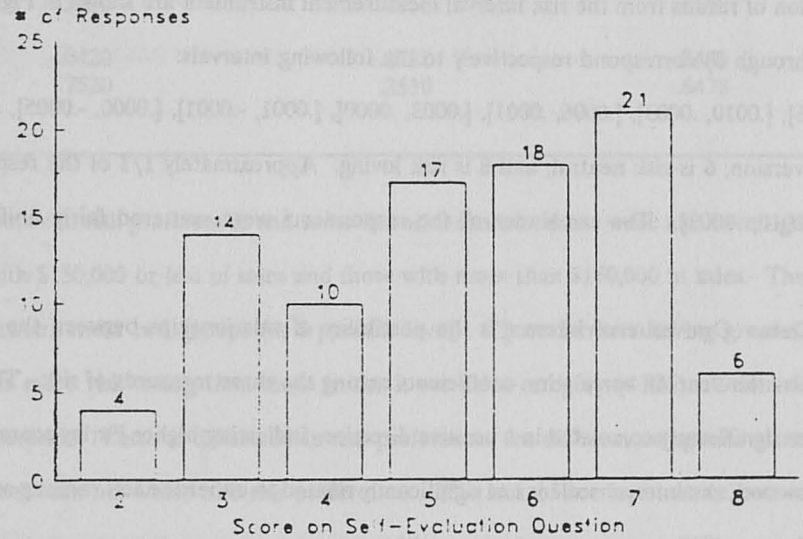
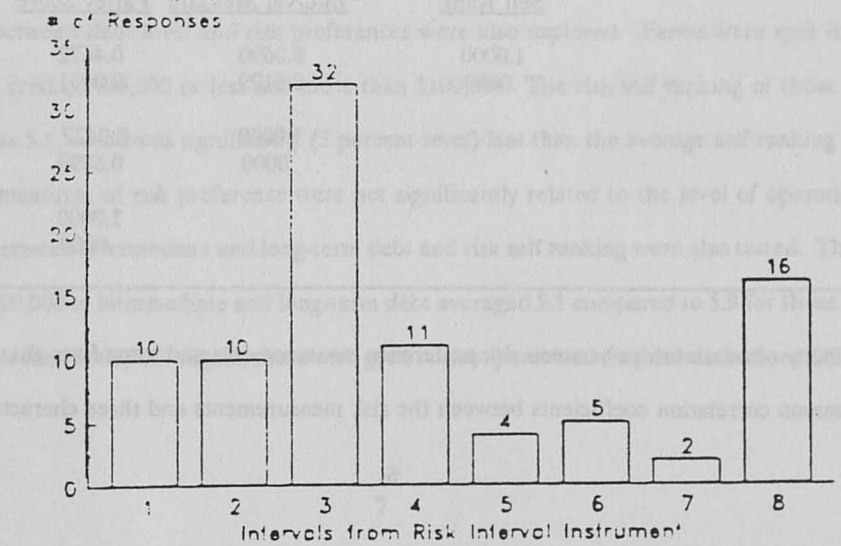


FIGURE III. DISTRIBUTION OF RESULTS OF RISK INTERVAL SURVEY INSTRUMENT



expected income based on the income distributions provided. Another interesting observation was the amount of discussion that the various instruments stimulated among the farm couples and partners who completed the questionnaire. Obviously, many farm management decisions are not made in a vacuum, and many decisions must certainly involve spouses, parents, siblings, and other business partners, as well as agricultural lenders.

There were 90 questionnaires with risk attitude questions completed correctly. Scores on the Farley test ranged from 6 to 17, with a mean of 11.9. Figure 1 shows the distribution of scores on the Farley test. Higher scores reflect greater affinity to risk.

The self-evaluation of risk preference question had a scale from 1 to 9, with 5 labeled as risk neutral and larger numbers reflecting greater affinity to risk. The responses on this question ranged from 2 to 8, with a mean of 5.3 (Figure 2). More people (45) ranked themselves on the risk loving side of the risk scale than on the risk averse side of the scale (28). This is in direct conflict with the frequent assumption in risk research that decision makers are risk averse.

The distribution of results from the risk interval measurement instrument are shown in Figure 3. The numbers on the horizonal axis (1 through 8) correspond respectively to the following intervals:
[∞, .0010], [.0050, .0006], [.0010, .0003], [.0006, .0001], [.0003, .0000], [.0001, -.0001], [.0000, -.0005], and [-.0001, -∞].
So, 1 is extreme risk aversion, 6 is risk neutral, and 8 is risk loving. Approximately 1/3 of the respondents fell in the risk aversion interval of [.0010, .0003]. The remainder of the respondents were scattered fairly uniformly across the other intervals.

Analysis of Data. One issue of interest is the possibility of relationships between the three measures of risk attitudes. Table II shows the Pearson correlation coefficients among the three measures of risk. The self-ranking measure and the Farley score are significantly correlated in a positive direction, indicating higher Farley scores associated with higher self-ranking scores. However, the interval scale is not significantly related to either the self-ranking score or the Farley score.

Table II. Pearson Correlation Coefficients for Three Risk Measures (Significance Levels below Coefficients)

	Self Rank	Interval Measure	Farley Score
Self Rank	1.0000	0.0690	0.4672
	.0000	0.5179	0.0001
Interval Measure		1.0000	-0.0427
		.0000	0.6898
Farley Score			1.0000
			.0000

The possibility of relationships between risk preference measurements and some farm characteristics was explored. Table III shows Pearson correlation coefficients between the risk measurements and three characteristics of farmers. The

self ranking measure was significantly related to farm type, years of experience (if 10 percent level of significance if used), and off-farm income. Farm type is a ratio of crop sales to livestock sales, so it reflects the source of income for the farm. Farms with a greater proportion of their income from crops perceived themselves as being less risk preferring individuals. Farmers with more years of farming experience ranked themselves as more risk preferring individuals. Finally, farmers with more off-farm income perceived themselves as less risk preferring individuals. All of these relationships are plausible.

Table III. Pearson Correlation Coefficients for Risk Preference Measurements and Other Characteristics (Significant Levels below Coefficients).

	Farm Type	Years Experience	Off-Farm Income
Self Rank	-.2812	.1878	-.2086
	.0310	.0763	.0485
Interval Measure	.0848	.0404	-.0473
	.5232	.7055	.6578
Farley Score	-.0420	-.1222	-.0488
	.7520	.2510	.6478

Relationships between risk preferences and some financial characteristics were also investigated. Farms were split into two groups, those with $150,000 or less in sales and those with more than $150,000 in sales. The risk self ranking was significantly different between these two groups (at 5 percent level). Those farmers having greater sales had an average ranking of 5.620, which is more risk loving than those in the lower sales category (4.925). Other risk measures were not related to sales of the operation. Tests of difference in risk preferences for different categories of net worth turned up no significant relationships between net worth and risk preferences. The lack of correspondence between net worth and risk preference is at odds with research on the risk preferences of Minnesota hog producers (Wilson and Eidman, 1983). The Minnesota study found that wealthier individuals were more risk averse. On the other hand, larger hog operations did display a greater willingness to take risks, a result that does concur with our findings.

Relationships between debt level and risk preferences were also explored. Farms were split into two categories based on their operating credit; $100,000 or less and more than $100,000. The risk self ranking of those in the group with $100,000 or less credit was 5.1, which was significantly (5 percent level) less than the average self ranking of 5.9 for farmers with more debt. Other measures of risk preference were not significantly related to the level of operating debt.

Relationships between intermediate and long-term debt and risk self ranking were also tested. The risk self ranking of those with less than $100,000 in intermediate and long-term debt averaged 5.1 compared to 5.9 for those with intermediate and long-term debt greater than $100,000. Again, those with greater debt perceived themselves as more risk loving than those with lower debt levels.

Conclusions. Three measures of risk preference were collected from 90 farmers along with additional information about the farmers and the farm operations. The self ranking measurement and the Farley test were correlated with each other, but neither was correlated with the risk interval survey instrument ranking. Of the three instruments, the risk interval survey instrument was the most difficult for respondents to fill out correctly. The complexity of this instrument may be beyond the ability of individuals for revealing their risk preference.

Characteristics of farms and farmers were also related to the three risk measures. However, the most sophisticated measurement of risk preference and the Farley test results were not effective in measuring anything that was significantly related to farm or farmer characteristics. The self ranking measure was significantly related to a number of characteristics in a plausible fashion. Farmers that ranked themselves as less risk preferring generally had more income from crops, less farming experience, more off farm income, fewer farm sales, less operating debt, and less intermediate and long-term debt. These relationships are all very reasonable. Other relationships were tested, but differences were not significant. The other two measures of risk preference were not significantly related to any of the characteristics examined.

One issue that can be raised is how to accommodate different risk preferences in extension programs. Extension agricultural economists are being called upon more frequently to provide intensive, in-depth educational programs in farm management and marketing. It may benefit program planners to spend some time determining the risk preferences of the likely participants of their programs. They could then structure their programs to account for differences in risk attitudes.

Extension farm management and marketing programs may need to be targeted to serve those groups that have the appropriate risk "profiles". Extension programmers may even want to consider "screening" program participants to "guide" them to specially tailored extension programs. These programs would address educational needs of all producers, but they would explicitly recognize that producers' risk attitudes may influence their willingness to adopt the management techniques that extension is imparting.

If agricultural economists want to incorporate "risk sensitivity" into their extension programming, they first need a simple and effective method of evaluating producers' risk attitudes. This paper suggests that neither the Meyer-type nor the Farley risk measurement techniques are adequate or reliable tests of producers' risk attitudes. The self-ranking test, however, shows promise. In the absence of a better or simpler test, we suggest that extension specialists employ this test when measuring producers' risk attitudes. We propose that extension programs in farm management and marketing help farmers to recognize and evaluate their risk attitudes and the impacts of these preferences on choice of risk management strategies.

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