# RISK PERCEPTIONS AND MANAGEMENT RESPONSES: PRODUCER-GENERATED HYPOTHESES FOR RISK MODELING

**George R. Patrick, Paul N. Wilson, Peter J. Barry, William G. Boggess, and Douglas L. Young**

**Abstract**

Farm level risk analyses have used price and yield variability almost exclusively to represent risk. Results from a survey of 149 agricultural producers in 12 states indicate that producers consider a broader range of sources of variability in their operations. Significant differences exist among categories with respect to the importance of the sources of variability in crop and livestock production. Producers also used a variety of management responses to variability. There were significant difference among categories in the importance given to particular responses and their use of them. These results have implications for research, extension, and policy programs.

*Key words:* risk, variability, perceptions, risk responses.

Challenges to one of the foundations of risk analysis, expected utility theory (EUT), have increased in number and intensity in recent years. Kahneman and Tversky have questioned EUT as an empirically validated theory by demonstrating through a series of rigorous experiments that respondent's behavior does not conform to the theory's assumptions. Results from experimental economics also have shown that individual behavior does not parallel the results expected from EUT. Individuals may be rational but they do not appear to optimize a utility function (Knez et al.). Wilde et al. are even stronger in their criticism of EUT. These authors argue that it is beyond the ability of individuals to optimize; moreover, this inability will increase as the information available to decisionmakers increases. Even Arrow, who has contributed significantly to the risk analysis literature, questions the economist's ability to empirically validate EUT.

Agricultural economists have drawn heavily upon the EUT paradigm to analyze resource allocation problems in agriculture. Early work by Lin et al. demonstrated that utility maximization more closely reflected actual behavior than did profit maximization. However, neither optimization criterion proved to be a close approximation for decisionmakers' actions. Both techniques produced optimal resource allocations which reflected more risk taking by the farm operator than was actually observed. Most agricultural economics research involving risk modeling has limited the sources of variability to output levels and commodity prices (Mapp and Helmers). Researchers have incorporated yield and price risk into quadratic programming, MOTAD, simulation, and stochastic dominance models. This narrow interpretation of risk has made risk analyses manageable and mathematically tractable, but has ignored other important sources of risk (Sonka and Patrick). For example, Sanint and

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Barry demonstrated that the incorporation of credit risk into the optimizing process raised overall risk, which in turn reduced the optimal solution in terms of variance and expected returns.

It is appropriate to begin a reevaluation of the data and risk modeling assumptions used by the profession. The accuracy of risk models may depend more on the data used than on the theoretical validity of EUT (Simon). This note attempts to generate hypotheses from producer responses about neglected areas of risk management. Also, this paper may serve as a source of ideas for improved risk modeling efforts and provide further insight on the designs of educational, research, and policy programs dealing with risk issues.

## SURVEY PROCEDURES

A sense of uneasiness about producer attitudes towards risk led a group of researchers to collect information concerning risk perceptions and management responses from agricultural producers in 12 states.[1] The survey was conducted in 1983 using a common survey instrument.[2] Dillman's Total Design Method was used to develop the questionnaire's format and a Likert scale was selected for ranking producer responses.[3] Survey techniques included personal interviews with respondents and telephone contacts followed by mailed questionnaires. Representatives from each of the participating states were asked to interview 10 or more producers who operated a production unit similar to one of the USDA typical farms (Hatch et al.). A total of 149 producers were interviewed.

Producers were asked to rank, on a scale from 1 to 5, the importance of various sources of variability which create risk in their farming or ranching operations. Crop and livestock enterprises were differentiated in the questionnaire. Respondents were also asked to assess, on a scale of 1 to 4, the importance of various management responses to variability and to indicate whether they used the method or tool. Socioeconomic data were obtained for each grower. Respondents were aggregated into five farm-type categories: mixed farming (Alabama, Florida, and Georgia); cotton (Mississippi and Arizona); corn, soybean, and hogs (Illinois and Indiana); small grain (Kansas, North Dakota, and Washington); and ranches (Arizona, Oklahoma, and Wyoming).[4]

The sample of producers does not represent a statistically representative sample. Budget and time constraints did not permit the researchers to draw a nationwide, stratified random sample of agricultural producers. Therefore, implications drawn from the survey's statistical findings are not considered representative of all producers. However, the results do provide valid observations for generating hypotheses that can legitimately challenge the conventional approaches to risk analysis in agricultural economics.

## SURVEY RESULTS

### Crop Production

Table 1 presents the mean values and standard deviations for the importance given to the sources of variablility in crop production by farm-type category. An F-test was used to determine whether there were differences in importance between producer categories. Farm-type comparisons reveal that weather was considered the most important source of variability in crop production, 4.59 on the 5-point scale. Crop prices ranked second; they are directly linked to other factors such as weather and government programs. These findings support modeling efforts that have only incorporated yield and price variability in their analyses. However, producers also ranked inflation, input costs, disease and pests, world events, and safety and health as other important sources of risk. The least important factors included hired labor, leasing cropland, and technology. It is important to note that factors beyond the control of the deci-

[1] The survey was conducted by a subcommittee of researchers participating in Southern Regional Research Project S-180, "An Economic Evaluation of Risk Management Strategies for Agricultural Production Firms." The states participating in this study were Alabama, Arizona, Illinois, Indiana, Florida, Georgia, Mississippi, Kansas, North Dakota, Washington, Oklahoma, and Wyoming.

[2] See Patrick for a copy of the questionnaire.

[3] The Total Design Method is a questionnaire design and survey implementation procedure which increases the probabilities of respondent cooperation and accurate responses. Emphasis is placed on reducing respondent burden in answering the questionnaire.

[4] Patrick has written a similar analysis using socioeconomic rather than farm-type comparisons.

TABLE 1. RELATIVE IMPORTANCE OF ALTERNATIVE SOURCES OF VARIABILITY IN CROP PRODUCTION BY FARM TYPE, SELECTED STATES, 1983[a]

| Source of variability | Farm type[b] | | | | | |
|---|---|---|---|---|---|---|
| | Mixed farming n=40 | Cotton n=21 | Corn, soybean, hogs n=21 | Small grain n=39 | Ranch n=12 | Average n=133 |
| Weather | 4.77 | 4.33 | 4.48 | 4.59 | 4.67 | 4.59 |
| | (.58)[c] | (1.02) | (.87) | (.87) | (.65) | (.80) |
| Diseases and pests | 4.38 | 3.95 | 3.38 | 4.03 | 2.73 | 3.91[f] |
| | (.96) | (.86) | (.86) | (.86) | (1.42) | (1.05) |
| Crop prices | 4.13 | 4.67 | 4.52 | 4.38 | 2.82 | 4.24[f] |
| | (1.20) | (.35) | (.81) | (.96) | (1.60) | (1.12) |
| Operating input costs | 3.69 | 4.33 | 4.05 | 3.87 | 4.00 | 3.93 |
| | (1.22) | (.80) | (1.16) | (1.15) | (1.10) | (1.12) |
| Capital equipment | 3.28 | 3.76 | 3.76 | 3.67 | 3.64 | 3.58 |
| | (1.34) | (1.18) | (.94) | (1.24) | (1.21) | (1.22) |
| Credit availability | 2.49 | 3.14 | 3.62 | 2.92 | 2.09 | 2.87[e] |
| | (1.67) | (1.31) | (1.36) | (1.29) | (1.45) | (1.45) |
| Credit cost | 2.92 | 3.57 | 4.00 | 3.49 | 2.55 | 3.34[e] |
| | (1.63) | (1.17) | (1.05) | (1.23) | (1.81) | (1.43) |
| Use of leverage | 2.68 | 3.29 | 3.62 | 2.92 | 2.36 | 2.98[d] |
| | (1.63) | (1.27) | (1.20) | (1.20) | (1.63) | (1.42) |
| Leasing cropland | 2.54 | 2.48 | 3.10 | 2.62 | 2.00 | 2.50 |
| | (1.60) | (1.54) | (1.58) | (1.31) | (1.18) | (1.48) |
| Technology | 2.84 | 2.67 | 3.19 | 2.79 | 2.73 | 2.85 |
| | (1.64) | (.86) | (.81) | (.95) | (1.00) | (1.16) |
| Gov't commodity programs | 2.97 | 3.90 | 3.05 | 3.72 | 3.72 | 3.30[e] |
| | (1.68) | (1.14) | (.74) | (1.28) | (1.28) | (1.48) |
| Gov't laws regulations | 2.59 | 3.38 | 3.05 | 3.23 | 2.73 | 2.99 |
| | (1.48) | (1.24) | (1.02) | (1.18) | (1.78) | (1.34) |
| Inflation | 3.79 | 3.90 | 4.14 | 4.08 | 3.55 | 3.93 |
| | (1.39) | (1.04) | (1.06) | (.84) | (1.75) | (1.18) |
| World events | 3.36 | 3.81 | 4.29 | 4.00 | 2.73 | 3.72[f] |
| | (1.35) | (.93) | (.85) | (1.00) | (1.68) | (1.22) |
| Safety and health | 3.56 | 3.62 | 4.00 | 3.54 | 4.00 | 3.67 |
| | (1.47) | (1.20) | (1.05) | (1.31) | (1.10) | (1.29) |
| Family plans | 2.38 | 3.10 | 3.95 | 3.08 | 3.36 | 3.04[f] |
| | (1.43) | (1.22) | (.97) | (1.29) | (1.03) | (1.34) |
| Hired labor | 2.28 | 2.76 | 2.00 | 2.49 | 2.82 | 2.42 |
| | (1.39) | (.77) | (.83) | (1.33) | (1.33) | (1.21) |

[a]A scale of 1 to 5 was used to rank producer responses on the importance of various sources of risk. Five (5) was used to indicate the highest level of importance.
[b]Mixed farming includes Alabama (22), Florida (9), and Georgia; cotton includes Mississippi (9) and Arizona (12); corn, soybeans, hogs includes Illinois (12) and Indiana (9); small grain includes Kansas (17), North Dakota (10), and Washington (12); and ranch includes Arizona (1), Oklahoma (4) and Wyoming (7).
[c]Standard deviations are indicated in parentheses.
[d]F values for between group differences are significant at the 10 percent level.
[e]F values for between group differences are significant at 5 percent level.
[f]F values for between group differences are significant at 1 percent level.

sionmaker contribute most significantly to variability.

Crop price variability was relatively unimportant for the small group of ranchers; however, their responses were typically about forage crops used in their ranching operations. Mixed farming and small grain producers considered diseases and pests an important source of variability. Although cotton producers expressed less concern about diseases and pests than some other groups, they gave the greatest importance to operating input costs of any farm-type group. Cotton and Midwestern corn, soybean, and hog (CSH) producers assigned greater importance to credit availability and the cost of credit than other growers. A similar pattern also occurred for the use of leverage.

Possible changes in government commodity programs were not among the most important sources of variability in crop production; however, significant differences occurred among the five farm-type groups. Mixed farming and CSH producers gave less importance to variability from commodity programs that cotton or small grain growers. Midwestern CSH producers gave much greater importance to family plans as a source of variability than other groups. The contrast is especially pronounced in relation to Southeastern mixed farming producers.

## Livestock Production

Table 2 presents the mean values and standard deviations for the importance given to sources of variability in livestock production

TABLE 2. RELATIVE IMPORTANCE OF ALTERNATIVE SOURCES OF VARIABILITY IN LIVESTOCK PRODUCTION BY FARM TYPE, SELECTED STATES, 1983.[a]

| Source of variability | Farm type[b] | | | | |
|---|---|---|---|---|---|
| | Mixed farming n=38 | Corn, soybean, hogs n=10 | Small grain n=23 | Ranch n=28 | Average n=99 |
| Weather | 3.63 | 4.10 | 3.64 | 4.32 | 3.88 |
| | (1.50)[c] | (1.10) | (1.29) | (1.06) | (1.32) |
| Diseases and pests | 3.62 | 4.20 | 3.62 | 3.61 | 3.68 |
| | (1.23) | (.92) | (1.36) | (1.31) | (1.25) |
| Livestock prices | 3.74 | 4.40 | 4.04 | 4.36 | 4.05 |
| | (1.27) | (.84) | (1.46) | (.91) | (1.41) |
| Operating input costs | 3.63 | 4.40 | 4.00 | 4.11 | 3.93 |
| | (1.44) | (.84) | (1.31) | (.92) | (1.24) |
| Capital equipment | 2.95 | 3.10 | 2.78 | 3.14 | 2.98 |
| | (1.59) | (1.10) | (1.09) | (1.18) | (1.32) |
| Credit availability | 2.11 | 3.10 | 2.74 | 2.64 | 2.51 |
| | (1.61) | (1.60) | (1.45) | (1.42) | (1.53) |
| Credit cost | 2.19 | 3.30 | 3.48 | 3.57 | 3.01[e] |
| | (1.69) | (1.64) | (1.59) | (1.45) | (1.69) |
| Use of leverage | 2.19 | 3.40 | 2.65 | 2.82 | 2.61 |
| | (1.60) | (1.50) | (1.40) | (1.52) | (1.54) |
| Leasing of land | 1.43 | 1.60 | 2.35 | 2.68 | 2.02[e] |
| | (1.01) | (.84) | (1.43) | (1.59) | (1.38) |
| Technology | 2.35 | 3.00 | 2.22 | 2.43 | 2.41 |
| | (1.48) | (1.49) | (1.20) | (1.10) | (1.31) |
| Gov't agr. programs | 1.62 | 3.10 | 2.30 | 3.43 | 2.45[e] |
| | (1.00) | (1.37) | (1.43) | (1.60) | (1.52) |
| Gov't laws regulations | 2.16 | 3.50 | 2.65 | 3.64 | 2.84[e] |
| | (1.38) | (1.51) | (1.58) | (1.34) | (1.55) |
| Inflation | 3.19 | 3.60 | 3.35 | 3.93 | 3.48 |
| | (1.64) | (1.58) | (1.43) | (1.39) | (1.52) |
| World events | 2.84 | 3.30 | 3.13 | 3.57 | 3.16 |
| | (1.57) | (.95) | (1.29) | (1.29) | (1.39) |
| Safety and health | 3.17 | 4.30 | 3.22 | 3.93 | 3.51[d] |
| | (1.55) | (1.34) | (1.68) | (1.18) | (1.51) |
| Family plans | 2.17 | 4.10 | 2.91 | 3.21 | 2.85[e] |
| | (1.56) | (1.10) | (1.53) | (1.37) | (1.56) |
| Hired labor | 1.95 | 2.70 | 2.48 | 2.48 | 2.30 |
| | (1.37) | (1.70) | (1.59) | (1.37) | (1.47) |

[a]A scale of 1 to 5 was used to rank producer responses on the importance of various sources of risk. Five (5) was used to indicate the highest level of importance.

[b]Mixed farming includes Alabama (19), Florida (7), Georgia (8), and Mississippi (4); corn, soybeans, hogs includes Indiana (10); small grain includes Kansas (17), North Dakota (2), and Washington (4); and ranch includes Arizona (5), Oklahoma (12), and Wyoming (11).

[c]Standard deviations are indicated in parentheses.

[d]F values for between group differences are significant at the 5 percent level.

[e]F values for between group differences are significant at the 1 percent level.

by producer group. Livestock prices were the most important sources of variability in livestock production—4.05 on the 5-point scale for the overall group. Operating input costs ranked second overall and were considered as important as livestock prices by Midwestern CSH producers. Overall, the importance of weather as a source of variability was nearly as important as operating costs. Western ranchers, as would be expected, gave greater importance to weather than operating costs as a source of risk. Diseases and pests were the fourth most important source of variability in livestock production overall and for all groups except the ranchers. Inflation, safety and health, and government laws and regulations were all considered more important than diseases and pests by Western ranchers.

A number of differences occurred in the importance given to sources of variability by producer categories. Producers in the Southeast (mixed farming) gave lower importance to the cost of credit than other producers. Small grain producers and ranchers both indicated greater concern with leasing provisions as a source of risk than other producers. This probably reflects their reliance on public lands for grazing. Both CSH producers and ranchers gave more importance to government agricultural programs and laws and regulations as sources of variability than the other groups. Safety and health as well as family plans were given much greater importance as sources of risk by Midwestern producers than other growers. Most of the CSH producers had confinement hog facilities

TABLE 3. RELATIVE IMPORTANCE OF ALTERNATIVE MANAGEMENT RESPONSES TO RISK BY FARM TYPE, SELECTED STATES, 1983[a]

| Response method | Farm type[b] | | | | | |
|---|---|---|---|---|---|---|
| | Mixed farming n=40 | Cotton n=21 | Corn, soybeans, hogs n=22 | Small grain n=39 | Ranch n=27 | Average n=149 |
| Production Responses: | | | | | | |
| Enterprise diversification | 3.14 (1.07)[c] | 3.19 (.93) | 2.68 (1.17) | 2.97 (1.11) | 2.65 (1.23) | 2.94 (1.11) |
| Geographic dispersion | 1.68 (1.12) | 1.48 (.81) | 1.73 (1.03) | 1.87 (1.02) | 2.17 (1.19) | 1.79 (1.09) |
| Production practices diversification | 3.00 (.89) | 2.71 (1.15) | 2.86 (.91) | 2.79 (.93) | 1.88 (1.09) | 2.68[f] (1.04) |
| Feed reserves (livestock only) | 3.03 (.95) | 2.17 (1.47) | 1.80 (1.23) | 2.73 (1.03) | 2.88 (.95) | 2.74[e] (1.08) |
| Maintaining flexibility | 2.49 (1.04) | 3.00 (1.10) | 2.38 (1.16) | 2.55 (.95) | 2.81 (1.21) | 2.63 (1.08) |
| Idling production capacity | 2.47 (.96) | 2.10 (1.00) | 1.95 (1.07) | 1.89 (.98) | 1.87 (1.01) | 2.07 (1.01) |
| Marketing Responses: | | | | | | |
| Spreading sales | 2.58 (1.13) | 3.19 (1.03) | 3.41 (.59) | 2.95 (.81) | 2.56 (1.28) | 2.88[f] (1.04) |
| Forward contracting | 2.95 (1.07) | 3.29 (.90) | 2.91 (.75) | 2.36 (1.16) | 1.96 (.98) | 2.66[f] (1.10) |
| Hedging | 1.39 (.87) | 1.90 (1.04) | 1.81 (.98) | 1.37 (.67) | 2.00 (1.25) | 1.63[e] (.97) |
| Market information | 3.00 (1.07) | 3.19 (.93) | 3.57 (.60) | 3.18 (.88) | 3.56 (.64) | 3.26[d] (.88) |
| Gov't commodity programs | 3.10 (1.05) | 3.14 (.96) | 2.50 (1.10) | 2.97 (.93) | 1.64 (.95) | 2.76[f] (1.11) |
| Financial Responses: | | | | | | |
| Hail insurance (crop only) | 1.29 (.75) | 2.62 (1.12) | 3.25 (1.12) | 2.09 (1.08) | [g] | 2.13[f] (1.22) |
| All-risk crop insurance (crop only) | 2.81 (1.21) | 1.67 (.80) | 1.25 (.72) | 1.44 (.88) | [g] | 1.87[f] (1.14) |
| Financial reserves | 3.14 (1.02) | 3.19 (.98) | 2.33 (1.11) | 2.47 (1.11) | 3.13 (1.18) | 2.84[f] (1.13) |
| Inventory reserves | 2.22 (1.23) | 1.38 (.67) | 1.33 (.66) | 2.42 (1.20) | 2.53 (1.26) | 2.04 (1.17) |
| Credit reserves | 2.50 (1.16) | 2.38 (1.24) | 2.57 (1.08) | 2.77 (1.01) | 2.96 (1.14) | 2.65 (1.12) |
| Debt management | 2.49 (1.38) | 1.90 (1.14) | 2.71 (1.38) | 2.16 (1.22) | 2.50 (1.35) | 2.35 (1.31) |
| Gov't emergency credit | 1.97 (1.28) | 1.52 (.98) | 1.71 (1.19) | 1.37 (.79) | 1.40 (.68) | 1.62[d] (1.04) |
| Pacing investments | 3.08 (1.05) | 3.52 (.75) | 3.38 (.92) | 3.56 (.82) | 2.52 (1.68) | 3.30[e] (.98) |
| Operator off-farm activities | 2.12 (1.34) | 1.81 (1.03) | 1.86 (1.20) | 1.90 (1.23) | 2.48 (1.36) | 2.02 (1.25) |
| Family off-farm activities | 1.94 (1.13) | 1.62 (.97) | 1.76 (1.09) | 1.87 (1.08) | 1.95 (1.07) | 1.85 (1.07) |

[a]A scale of 1 to 4 was used to rank producer responses on the importance of various management responses to variability. Four (4) was used to indicate the highest level of importance.

[b]Mixed farming includes Alabama (22), Florida, (9) and Georgia (9); cotton includes Mississippi (9) and Arizona (12); corn, soybeans and hogs includes Illinois (12) and Indiana (10); small grain includes Kansas (17), North Dakota (10) and Washington (12); and ranch includes Arizona (4), Oklahoma (12) and Wyoming (11).

[c]Standard deviations are indicated in parentheses.

[d]F values for between group differences are significant at the 1 percent level.

[e]F values for between group differences are significant at the 5 percent level.

[f]F values for between group differences are significant at the 10 percent level.

[g]Only 2 of the 27 Western ranch producers responded to the hail and all-risk crop insurance questions. Hail insurance and all-risk crop insurance were both considered as not important.

with continuous labor requirements causing concern about the operator's health.

## Management Responses to Variability

Table 3 presents the mean importance of the various production, marketing, and financial responses to variability by producer category with the associated standard deviations. A four-point scale with 4 indicating "very important" and 1 denoting "not important" or "does not apply" was used. Pacing of investments and expansion to avoid becoming overextended was considered the most important (3.30) managerial response to risk. Obtaining market information was a close second (3.26). These responses were used by about 90 percent of the respondents.[5]

[5]These percentages are not included in this note but can be obtained from the authors.

None of the other managerial responses received values exceeding 2.95 or were used by over 80 percent of the producers.

Among the production responses, enterprise diversification was the most important one for cotton growers, Southeastern producers with mixed farming operations, and small grain producers. Ranchers gave the greatest importance to maintaining feed reserves. CSH producers ranked production practice diversification as their most important production response.

Significant differences occurred among the farm-type categories in the importance given to all of the marketing responses to risk. More than 90 percent of producers obtained market information, but the importance ranged from 3.00 for the mixed farming producers to 3.57 for the Midwestern CSH producers. Spreading sales (sequential selling) and forward contracting were used by over 77 percent of the respondents. Forward contracting was given greater importance by mixed farming and cotton producers, while spreading sales was given greater emphasis by the remaining groups. Overall, hedging was regarded as the least important of the marketing responses. Hedging was used by 25 percent or more of the respondents in the cotton, CSH, and ranch categories. Mixed farming and small grain producers considered hedging as unimportant, with few using this tool. Maintaining eligibility for participation in government commodity programs was considered important with 90, 89, and 80 percent of the cotton growers, small grain producers, and mixed farming operators using this risk management tool, respectively. In contrast, only 67 percent of the CSH producers indicated use of government commodity programs to manage risk.

Financial responses to variability were significantly different across farm types. The importance given hail insurance ranged from 3.25 for Midwestern CSH producers to 1.29 for Southeastern mixed farming producers. However, mixed farming producers had an average value of 2.81 for all-risk crop insurance compared with 1.25 for CSH producers. More than 77 percent of the mixed farming producers had crop insurance and 19 percent had hail insurance. In contrast, 81 percent of the CSH producers had hail insurance and less than 6 percent had all-risk crop insurance.

Other financial responses that differed significantly by producer category included financial reserves, the use of government emergency credit, and pacing of investments. CSH and small grain producers gave less importance to holding financial reserves such as bank accounts, bonds, or other financial assets than other farm-type operations, and lower percentages of these producers held reserves in these forms. Cotton and CSH producers gave less importance to inventory reserves. Mixed farming operations in the Southeast relied more heavily on emergency credit programs, while ranchers gave less importance to pacing investments as a risk management tool.

## RISK MODELING IMPLICATIONS AND HYPOTHESES

Results indicate that responding producers view weather, output prices, and input costs as the more important sources of variability in both crop and livestock production. The various producer categories also give differing importance to credit costs, government programs, and family plans as sources of variability in both crop and livestock production. Similar differences among producer categories also occur for the importance of diseases and pests and world events in crop production. Livestock producer categories also differed in the importance of government regulations, concerns about safety and health, and leasing of land as sources of variability. This suggests that researchers concerned with measuring producers' risk attitudes and developing effective risk management strategies should consider a wider range of sources of variability than just prices and yields as is common.

Obtaining market information and pacing of investments were considered the most important managerial responses to variability and were the most commonly used alternatives. Southeastern mixed farming producers and Western small grain producers placed considerable importance on diversification of enterprises and production practices as well as maintaining eligibility for government programs. Cotton producers emphasized forward contracting and spreading sales. Spreading sales, hail insurance, and production practice diversification were other important responses for Midwestern CSH producers. Maintaining financial, feed, and credit reserves were the other primary responses of Western ranchers.

These results have interesting implications for the design of educational programs, policy analysis and formulation, research, and the generation and dissemination of decision information. The heavy emphasis on marketing strategies in educational programs with farmers appears to be warranted and of significant payoff in light of the importance that producers give to marketing responses to variability. In addition, including marketing education with lenders, as well as financial management programs with both farmers and lenders, appears important in light of these survey responses. The interrelationships among marketing, debt management, and credit relationships with lenders are likely very important for credit-using farmers.

For policy analysis, these results indicate that a heavy emphasis on production practices and crop organizations as components of, or responses to, public farm programs may be misdirected if producers, indeed, exhibit their responses to variability (and other factors) more prominently in other ways—primarily in marketing and selected financial responses to risk. Thus, basing changes in commodity programs solely on supply responses to risk and other production factors may overlook the importance of producers' responses in marketing and finance. In general, policy formulation and analyses should consider the use of integrated risk strategies by producers in which alternatives in marketing and finance at least are as prominent as risk responses in production. As shown previously, the unpredictability of government commodity programs alone is a significant source of variability for many producers.

Producers indicate considerable concern for the viability of the firm over time and their ability to withstand adverse outcomes. Continued research emphasis on the integration of production, marketing, and financial responses into risk management strategies is important. These strategies will differ among producer categories and will need to reflect more specific characteristics of firms such as size and financial condition. Multi-year, rather than single period, analysis may produce more useful information for understanding and guiding behavior.

These producers' responses indicate the importance given to various types and sources of "information" that is a vital part of the decisionmaking process. In the marketing area, the farmers gave strong importance to the use of market information in responding to variability. This includes outlook information and reports on market conditions, production situation, and world economic conditions. Apparently, then, the firms and agencies that produce this information should have a high payoff. Other types of financial information may have strong importance as well. Producers also expressed a need for improved procedures to utilize information.

In their informal responses during the survey process, producers did indicate that they combined risk management tools into their overall management strategy. However, in many instances producers articulated a "philosophy of life" which they followed in decisionmaking rather than some optimization criterion. Many producers expressed more concern about the level of income than the variability of income. Emphasis in their responses was commonly placed on the intermediate or longrun rather than shortrun concerns. Many producers also indicated what could be interpreted as substantial "safety-first" considerations in their decisionmaking.

Concepts such as risk balancing and the trade-off between expected income and risk were recognized by about half of the producers interviewed. Some responses were: "...if I borrow money for cattle, I hedge."; "...if crop yields are low, I realize how important it is to market prudently and strive harder to do so."; and "By planting seed corn I give up high potential income from commercial corn in return for lower guaranteed income, thus reducing risk." But other producers indicated that they avoided risk balancing, considered the overall business when making a decision, and avoided situations where taking one action would require an offsetting action. In some cases, growers focused on giving up current income or investment for future income rather than on income-risk trade-offs.

This discussion leads to the following risk modeling hypotheses.

1. Decisionmaking criteria vary across geographic regions and by farm type. Risk modeling techniques should be adapted to the unique conditions of the research domain because standardized modeling formulations can produce spurious results.
2. Risk models which consider only commodity price and yield variability underestimate the importance of risk in the decisionmaking process. As a minimum requirement, production (in-

cluding inputs), marketing, and financial considerations must be intergrated into a realistic decisionmaking framework.

3. Agricultural producers view their business environment in a multi-period fashion where "safety-first" considerations are emphasized.
4. Information management for financial and marketing decisionmaking is a significant constraint to the success of many producers.
5. Stabilization of macroeconomic variables such as inflation, interest rates, government farm policies, and government regulations does as much to improve the risk position of producers as any management action taken by the individual grower.

Although the information presented is not definitive in a scientific sense, it does raise significant questions about the traditional modeling of risk in the agricultural sector. More risk modeling research, which rigorously tests the hypotheses generated by this sample of producers is needed. It may be years, if ever, before an acceptable replacement for EUT is developed and empirically validated. In the meantime, agricultural economists should attempt to use the most relevant assumptions and data available to model risk within the existing economic paradigm. Otherwise, efforts may be deemed misguided, if not irrelevant.

## REFERENCES


Arrow, K. J. "Risk Perception in Psychology and Economics," *Econ. Inquiry,* 20(1982): 1-9.

Dillman, D. A. *Mail and Telephone Surveys: The Total Design Method,* John Wiley and Sons, New York, 1978.

Hatch, Thomas C., Cole Gustafson, Kenneth Baum, and David Harrington. "A Typical Farm Series: Development and Application to a Mississippi Delta Farm," *So. J. Agr. Economics,* 14,2(1982): 31-6.

Kahneman, D. and A. Tversky. "Prospect Theory: An Analysis of Decision Under Risk," *Econometrica,* 47(1979): 263-91.

Knez, P., V. L. Smith, and A. W. Williams. "Individual Rationality, Market Rationality and Value Estimation," *Amer. Econ. Rev.,* 75(1985): 397-402.

Lin, W., G. Dean, and C. Moore. "An Empirical Test of Utility Versus Profit Maximization in Agricultural Production," *Amer. J. Agr. Econ.,* 56(1974): 497-508.

Mapp, Harry P. and Glenn A. Helmers. "Methods of Risk Analysis for Farm Firms." In *Risk Management in Agriculture,* ed. Peter J. Barry, Ames, Iowa; Iowa State University Press, 1984, pp. 116-28.

Patrick, George F. "Producers' Attitudes, Perceptions and Management Responses to Variability," *Risk Analysis for Agricultural Products Firms: Concepts, Information Requirements and Policy Issues,* Department of Agricultural Economics, University of Illinois, AE-4574; July, 1984; pp. 197-236.

Sanint, L. R. and P. J. Barry. "A Programming Analysis of Farmers' Credit Risks," *Amer. J. Agr. Econ.,* 65(1983): 321-5.

Simon, H. A. *Reason in Human Affairs,* Stanford University Press, Stanford, California, 1983.

Sonka, S. T. and G. F. Patrick. "Risk Management and Decision Making in Agricultural Firms." In *Risk Management in Agriculture, ed.* Peter J. Barry, Ames, Iowa; Iowa State University Press, 1984, pp. 95-115.

Tversky, A. and D. Kahneman. "The Framing of Decisions and the Psychology of Choice," *Science,* 211(1981): 453-8.

Wilde, K. D., A. D. LeBaron, and L. D. Israelsen. "Knowledge, Uncertainty, and Behavior," *Amer. Econ. Rev.,* 75(1985): 403-8.