AGRICULTURAL ECONOMICS

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Cornhusker Economics

Do Hypothetical Choices Indicate True Risk Preferences? A comparison of stated and revealed data on decisions over risky outcomes

Market Report	Year Ago	4 Wks Ago	8-19-16
Livestock and Products, Weekly Average			
Nebraska Slaughter Steers, 35-65% Choice, Live Weight.	149.00	115.50	117.50
Nebraska Feeder Steers, Med. & Large Frame, 550-600 lb.	272.37	*	*
Nebraska Feeder Steers, Med. & Large Frame 750-800 lb.	219.31	*	151.38
Choice Boxed Beef, 600-750 lb. Carcass.	245.75	201.39	201.24
Western Corn Belt Base Hog Price Carcass, Negotiated	74.88	69.95	63.38
Pork Carcass Cutout, 185 lb. Carcass 51-52% Lean.	88.09	88.78	73.71
Slaughter Lambs, wooled and shorn, 135-165 lb. National.	155.36	*	162.81
National Carcass Lamb Cutout FOB.	354.96	353.65	359.00
Crops, Daily Spot Prices			
Wheat, No. 1, H.W. Imperial, bu.	4.14	3.07	3.02
Corn, No. 2, Yellow Nebraska City, bu.	3.55	3.07	2.99
Soybeans, No. 1, Yellow Nebraska City, bu.	9.20	9.53	9.67
Grain Sorghum, No.2, Yellow Dorchester, cwt.	5.96	4.64	4.63
Oats, No. 2, Heavy Minneapolis, Mn, bu.	2.49	2.61	2.30
Feed			
Alfalfa, Large Square Bales, Good to Premium, RFV 160-185 Northeast Nebraska, ton.	177.00	165.00	158.75
Alfalfa, Large Rounds, Good Platte Valley, ton.	85.00	75.00	72.50
Grass Hay, Large Rounds, Good Nebraska, ton.	82.50	*	70.00
Dried Distillers Grains, 10% Moisture Nebraska Average.	139.00	127.50	122.50
Wet Distillers Grains, 65-70% Moisture Nebraska Average.	42.50	35.25	33.25

*** No Market**

Understanding how individuals make decisions when outcomes are risky is of significant interest to policymakers, economists, and businesses. The answer to questions such as why some drivers purchase the minimum legally allowable level of car insurance while others buy higher coverage, or why some producers buy the highest coverage available for crop insurance, while others do not purchase any insurance is that different people have different *risk preferences*. Risk preferences are varying attitudes or preferences toward different types of risks.

Agricultural risk usually arises from uncertain weather and market outcomes. For example, a producer does not know at the beginning of the season if he/she will receive sufficient precipitation for full yields or if erratic demand and supply conditions in the commodity market will affect output prices. Understanding how a producer will respond to this risk helps policymakers design policies such as crop insurance that help a producer manage risk, or predict the impacts of risk on the use of resources such as land, water, and fertilizer. The majority of empirical evidence suggests that most individuals are *risk averse*, meaning that they would choose a fixed payment over a fair gamble with the same expected outcome. In other words, most people would choose a guaranteed payment of $10,000 instead of a lottery with equal probabilities of receiving $20,000 or receiving nothing[1].

[1] Of course, there are always some people, who we refer to as *risk loving*, who would prefer the lottery to the fixed payment.

One of the difficulties in measuring risk preferences from actual behavior (i.e., revealed risk preference) is that it requires a lot of information. For example, estimating the risk preference of an individual producer requires many years of data on his/her input use, input prices, yield, and revenue. An alternative method that researchers have used is an experiment (i.e., a controlled game) that requires an individual to make choices when outcomes are uncertain. This is a *stated risk preference*. For example, a researcher could ask someone if he/she prefers a guaranteed payment of $10,000 or a lottery with equal probabilities of receiving $23,000 or receiving $100. While it takes less time to collect information using an experiment than with actual production data, it is difficult to know if those responses are accurate reflections of what a person will do when faced with risky outcomes in his/her life. Evidence that individuals behave similarly in how they make choices in a lottery and how they make choices on a farm means that researchers and policymakers can be confident in predictions made from experimentally-derived outcomes, something that will allow policymakers to adapt more quickly to changing risks.

Estimating revealed and stated risk preferences: In a recent project, we compared risk preferences of crop producers derived from actual on-farm production with choices from a simple lottery. In our empirical model we assume that a producer makes decisions based on a safety-first rule instead of expected utility. Making decisions based on expected utility means that a producer cares equally about upside and downside risk; while a safety-first rule means that a producer cares more about downside risk.

We calculate two measures of risk preferences, the risk aversion level and the risk premium. The risk aversion level k is the amount of expected income a producer is willing to give up in order to reduce his/her profit risk by $1. The higher the risk aversion level, the more risk averse a person is. The risk premium depends on both the risk aversion and the riskiness of outcomes. Specifically, the risk premium is calculated as $k\sigma_\pi$, where σ_π is the standard deviation of profit. The risk premium can be interpreted as the amount of profit a producer is willing to give up in order to eliminate any profit risk.

The stated risk preference measures are determined from a series of 14 hypothetical lottery questions, each with two response choices. The questions were asked in a 2013 mail survey of crop producers in Nebraska, Iowa, and South Dakota. In each case, the first option is a guaranteed payment and the second is a random return with equal probability of a high and low return. We observe the point where the producer shifts from the guaranteed choice to the riskier alternative. The *switch point* becomes the stated risk preference measure. If a producer switches early then he is less risk averse than a producer switching later. We scale the switch point to be between 1 and 2, where a '1' indicates that a producer is very risk averse and a '2' indicates a producer is not risk averse.

The revealed risk preference measures are derived from the United States Department of Agriculture's (USDA) Census of Agriculture along with data from the survey mentioned above. The panel is unbalanced and has 3083 observations in total, where Nebraska has 1162, Iowa has 1556 and South Dakota has 367. The key variables of interest for determining output elasticity and risk preference parameters are the expenditure variables for fertilizer, chemicals, seed, fuel, utilities, and supplies.

Table 1 shows the average estimated risk aversion and risk premium for each state. These are based on the revealed risk preferences. The average risk aversion is slightly higher in Nebraska (0.348) than Iowa (0.316), yet the average risk premium is higher in Iowa ($36.31 per acre to $26 per acre). Recall that the premium not only depends on the risk aversion, but also the standard deviation of income (σ_π). The observed variance of the risk aversion and premium measure, is also higher in Nebraska (0.195; $20.77 per acre) than Iowa (0.121; $13.95 per acre). The high variance in Nebraska is being driven by the combination of irrigated and dryland farmers. A lower risk aversion and risk premium level in South Dakota (relative to Iowa and Nebraska) can be explained by lower average per-acre yield and revenue.

Table 1: Mean Risk Preference Measures (Revealed Risk Preferences)

Risk Preference	Nebraska	Iowa	South Dakota
Aversion	0.348 [0.195]	0.316 [0.121]	0.236 [0.033]
Premium	26.93 [20.77]	36.31 [13.75]	22.95 [12.76]
Standard deviation of measure in brackets			

One of the main goals of our analysis is to determine if the stated risk preferences from a lottery are strong predictors of the calculated revealed risk preferences. To do this we use statistical regression to predict the stated risk preference as a function of revealed risk aversion and premium along with other explanatory variables (e.g., education, age, gender, irrigation use).

We test several specifications of the regression to measure the robustness of our results. We find some statistical support for the hypothesis that revealed risk preferences (those based on actual production decisions) predict stated risk preferences (those based on the lottery game). Our results show that a one unit increase in revealed risk aversion level decreases the switch point by 0.08 to 0.24. On average, this indicates that a one unit increase in the marginal risk aversion level means that the expected payout in a fair lottery needs to increase by $1,000 for an individual to choose the lottery instead of a guaranteed payment of $10,000. The other explanatory variables are mixed in their economic and statistical significance. We find no statistical relationship between the total sales, age, and farm asset variables and stated risk preference. Consistent with previous literature, we find that higher levels of formal education are correlated with more risk averse preferences.

Overall, our results find limited support for using experiments or controlled games instead of actual production data to estimate risk preferences. We also find a stronger correlation between choices derived from a safety-first prediction of behavior than with a prediction based on expected utility. Thus, results also support the hypothesis that a safety-first rule is a better representation of actual preferences than expected utility. While these results need to be examined with other types of experiments and in other regions, they are encouraging about the use of preference elicitation games in meeting the needs of policymakers.

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