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Safety First Risk Preferences and Post-Harvest Grain Marketing A Context-rich Lab Experiment

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Market Report	Year Ago	4 Wks Ago	2-28-20
Livestock and Products, Weekly Average			
Nebraska Slaughter Steers, 35-65% Choice, Live Weight.	*	124.00	*
Nebraska Feeder Steers, Med. & Large Frame, 550-600 lb.	180.85	176.98	179.59
Nebraska Feeder Steers, Med. & Large Frame 750-800 lb.	145.98	150.40	146.74
Choice Boxed Beef, 600-750 lb. Carcass.	219.98	214.78	206.34
Western Corn Belt Base Hog Price Carcass, Negotiated	44.81	*	*
Pork Carcass Cutout, 185 lb. Carcass 51-52% Lean.	59.64	77.21	64.05
Slaughter Lambs, wooled and shorn, 135-165 lb. National.	134.24	NA	160.41
National Carcass Lamb Cutout FOB.	374.77	421.58	424.41
Crops, Daily Spot Prices			
Wheat, No. 1, H.W. Imperial, bu.	4.03	4.37	4.10
Corn, No. 2, Yellow **Columbus**, bu.	3.52	3.68	3.64
Soybeans, No. 1, Yellow **Columbus**, bu.	8.06	8.27	8.36
Grain Sorghum, No.2, Yellow Dorchester, cwt.	5.45	5.91	5.74
Oats, No. 2, Heavy Minneapolis, Mn, bu.	3.13	3.32	3.18
Feed			
Alfalfa, Large Square Bales, Good to Premium, RFV 160-185 Northeast Nebraska, ton.	175.00	*	*
Alfalfa, Large Rounds, Good Platte Valley, ton.	105.00	107.50	*
Grass Hay, Large Rounds, Good Nebraska, ton.	92.50	95.00	95.00
Dried Distillers Grains, 10% Moisture Nebraska Average.	144.50	149.00	141.58
Wet Distillers Grains, 65-70% Moisture Nebraska Average.	50.00	50.00	50.67
* No Market			

Improving our understanding of the influence of risk-preferences on decision making represents an important objective for understanding behavior, designing policy and decision making theory. A natural place this problem persists is in the marketing of grain (Kastens and Dhuyvetter, 1999). Grain marketing research has primarily focused on the use of different marketing techniques that result in lower price risk and, therefore, lower income risk (Musser, Patrick, Eckman, 1996). However, the extent to which the theoretical findings from these studies are relevant to real-world applications is not clear (Brorsen and Irwin, 1996; Garcia and Leuthold, 2004). While reducing income risk is desired, this approach overlooks the influence of producer risk preferences when marketing grain. In this article we evaluate the role of producer risk preferences, specifically *Safety-First* (SF)risk preferences (Roy 1952) on grain marketing decision behavior with emphasis on post-harvest grain marketing.

The idea behind SF is that individuals consider outcomes below a particular value as a disaster. Each individual would have his/her own disaster level. For farmers, a disaster could mean losing the farm or losing money in a particular crop year. Producers exhibiting SF risk preferences will make on-farm decisions in a way to minimize the probability of achieving the disaster. For example, Fishburn (1997) found decision makers do associate risk with failure to meet a target return. Heady (1952) presented that farmers exhibit SF preferences by allocating acres to particular crops in an attempt to minimize the probability of income falling below a disaster level defined as production costs. Given this context, we used a grain marketing simulation game to conduct a context-rich economic experiment with university student subjects to evaluate the role of SF risk preferences on grain marketing decision behavior.

For our economic experiment and given our focus on SF risk preferences, we relied on the work by Levy and Levy (2009) to identify whether experimental subjects exhibit SF risk preferences. This information is then combined with post-harvest grain marketing decisions made during the experiment within the simulated grain marketing interphases where subjects create contracts for spot or future grain delivery under four different grain price scenarios.

Price Scenarios and Grain Marketing

The four price treatments were selected from marketing years with specific price characteristics. In all treatments the spot price at harvest, i.e. the cash price for October, was above the production cost which was 3.8 Experimental Currency Units (ECU) per bushel. However, the spot price did not exceed 4.1 ECUs per bushel. In Treatment 1 (hereafter "Stable" Price Series or T1), the expected price for each month was, on average, 4.2 ECUs with a standard deviation of 0.16. The minimum net price displayed was 3.5 ECUs and the maximum available price in T1 was 4.1 ECUs. In Treatment 2 (hereafter "Decreasing" Price Series or T2), prices followed a decreasing trend with the expected price per month, on average, being 3.8 ECUs per bushel with a standard deviation of 0.09. This parameterization led to a minimum net price of 2.5 ECUs per bushel and a maximum net price of 4 ECUs per bushel. The T2 series was constructed using actual price data from the 2002 marketing year and had no carry opportunities. Treatment 3 (hereafter "Erratic" Price Series or T3) had both increasing and decreasing trends changing multiple times throughout the year. The expected price per month was, on average, 4.7 ECUs with a standard deviation of 0.31, minimum net price of 3.2 ECUs and maximum net price of 5.4 ECUs. T3 was developed from information on 2003 marketing year prices. Finally, in Treatment 4 (hereafter "Increasing Price Series or T4), prices were increasing from month to month. The expected price per month was, on average, 5.5 ECUs with a standard deviation of 0.62, minimum net price of 3.9 ECUs, and maximum net price of 6.4 ECUs. The T4 series was created using 2006 prices. This price series had the highest net price of all treatments and its lowest net price did not fall below production costs of 3.8 ECUs per bushel. In all other treatments the minimum net price didn't cover the production cost.

Experimental Design

The experiment had three stages. The first stage involved elicitation of the risk attitude of the experimental subjects following Levy and Levy (2009). In the second stage, subjects participated in an experiment involving selling a fixed endowment of the post-harvest crop during different months of four years to maximize their profits. Each year began in October as typically this is the month in which producers start selling their corn and soybean harvests (USDA Agricultural Handbook Number 628, 1997) and ended in September of the next year. Decisions were made at the beginning of each month giving rise to 12 decision points for each year. Finally, in the third stage, participants took a non-paying survey which included questions about their general understanding of probabilities and expected value, knowledge of farming and grain marketing and some demographic characters.

Stage 2 of the experiment was implemented through the grain marketing interphase – Marketing in a New Era (MINE) (Kotsakou et al. 2018) in which subjects were aware that the item they were selling was an agricultural commodity; thus, considerably increasing the salience of our experimental findings.

The price scenario treatment was implemented in a within-subjects design. At the beginning of a marketing year, participants were informed that (i) the prices they would face in different years were independent of each other, (ii) their performance (measured by their profit) would not be influenced by the same in previous years and that (iii) all prices displayed would be net of storage cost of $0.07 ECUs per bushel. Subjects started the experiment with the same grain endowment (117,500 bushels) and had the same storage cost (0.07 ECUs per bushel). The total production cost was fixed at 446,500 ECUs for all participants and under all treatments. The only marketing period price with a zero storage cost was the spot price in October, the first month of the marketing year.

Decision making in a month involved subjects selling grain in 5,000 bushel increments. At every decision-making stage in a month, a table containing grain prices was displayed. The first price in the first row of the first column was the price offered in the spot market in October for immediate delivery. All other price information pertained to futures delivery i.e. the subject would receive the price they locked-in to sell their grain at minus the storage cost that is associated with storing the harvested grain until the month of sale. To facilitate decision making, subjects could sell grain in batches of 5000, 10,000, 15,000, 20,000, or 25,000 bushels during a month. If multiple transactions were made during a month, information pertaining to the details of each transaction (including the amount contracted and sold – if a spot contract and contracted price and month of sale if a future contract) was individually displayed along with information about total storage cost and total revenue before subjects proceeded to the next month. Subjects were informed that grain would not be carried over from one year to the next. Thus, if subjects had any grain remaining in September of the next year, this amount would be sold by the computer at the spot price for September.

Before proceeding to the next marketing year, subjects were provided detailed information about all their decisions in the current year including total earnings and total storage cost incurred. On the left side of the screen, all sales and storage expenses were listed in chronological order starting from the most recent transaction (charge or sale). On the right side of the screen, earnings for that year were displayed. The results screen also indicated the number of years remaining until the conclusion of Stage 2.

To facilitate subject understanding, in addition to instruction handouts and a presentation by the experimenter, there was a practice year with two months during which they had to make decisions. The price series used in the practice period was different from the price series used in the treatments.

Subjects were paid on the basis of decisions made in Stages 1 and 2. Subject's total earnings were converted to real U.S. dollars at an exchange rate of $1 per 12,611 ECUs earned in the experiment. With a flat show-up fee of $7, on average participants earned $22 with a standard deviation of $6.82, a minimum of $7 and a maximum of $40. This study was conducted with undergraduate and graduate students from the University of Nebraska in Lincoln as well as vocational students from the Nebraska College of Technical Agriculture (NCTA) in Curtis, Nebraska who receive specialized training in both commodity and animal agriculture. Subjects were randomly recruited from the University campus in Lincoln and a convenience sample was recruited from the much smaller student body at NCTA to give rise to a data set of 131 students who participated in our experiments lasting for two hours. Data was collected between January and April of 2017.

Empirical Estimation Strategy

Our empirical approach is to identify the effects of SF risk preferences on bushels contracted by month. Elements like marketing knowledge, age, gender, and experiment knowledge could have contributed to the number of bushels sold. Therefore we estimate the following equation:

$$Bu\_Sold_{it} = \alpha + \beta SF + \gamma MixedSF + \delta Treatment + \theta Order + \vartheta Controls + \varepsilon_{it}$$

where represents the percent of bushels sold (bushels sold/bushels in storage) by subject *i* in year *t*; SF represents a vector taking the value 1 if producers displayed SF risk preference, and zero otherwise; *Mixed SF* represents a vector taking the value 1 if producers displayed a mix of SF risk preferences (i.e., they answered some questions SF and others not), and zero otherwise (both these variables were computed on the basis of data from Stage 1 of the experiment); *Treatment* represents a matrix of price treatment effects where there is a dummy variable for each price treatment; *Order* represents a matrix order effect where there is a dummy variable for each order in which prices were presented to subjects; *Controls* represents a matrix of and continuous variables for factors that may influence hedging. These include Campus location (Lincoln or Curtis), familiarity with grain marketing (four categories ranging from not familiar to familiar); participant age (a continuous variable); expected value (a question on whether the participant understood the expected value concept); clear instructions (whether instructions were clear); and first experiment. are $\alpha, \beta, \gamma, \delta, \theta$ and ϑ estimated parameters; and ε_{it} represents the error term. The constant represents someone who displayed no SF risk preferences, a particular treatment, a particular order, and one dummy variable from each category in the control group. Equation 1 is estimated using two specifications. The first specification represents all bushels sold, regardless of contract type. The second specification represents bushels sold as cash contracts.

Results

Figures 1 and 2 describe the average number of bushels sold by month and for the spot market. The difference between bushels sold by month and spot market represents forward contracts (Note that positive returns to the carry did exist in one of the four price series. Meaning that it was financially beneficial to sell now for delivery in the future.) Visually, there is a very small difference between people on the basis of their risk types when looking at bushels sold, whereas for spot market sales, we see a substantially higher amount sold for those with SF risk preferences.

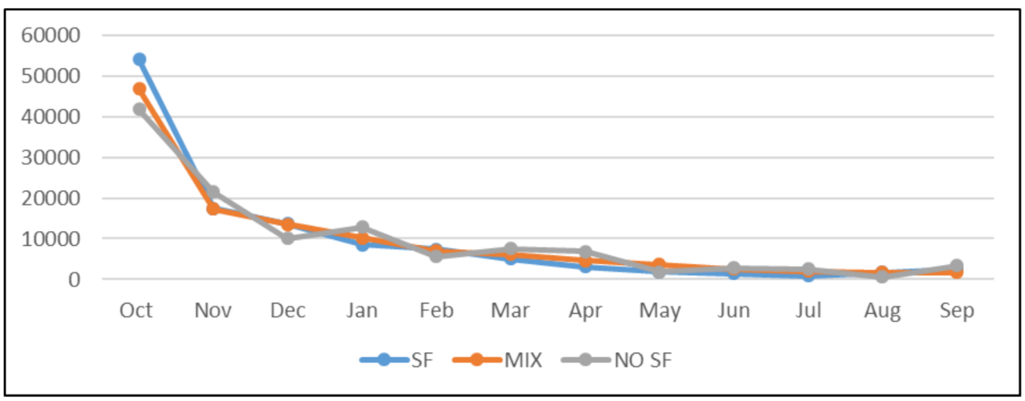

Figure 1. Total Bushels sold by month

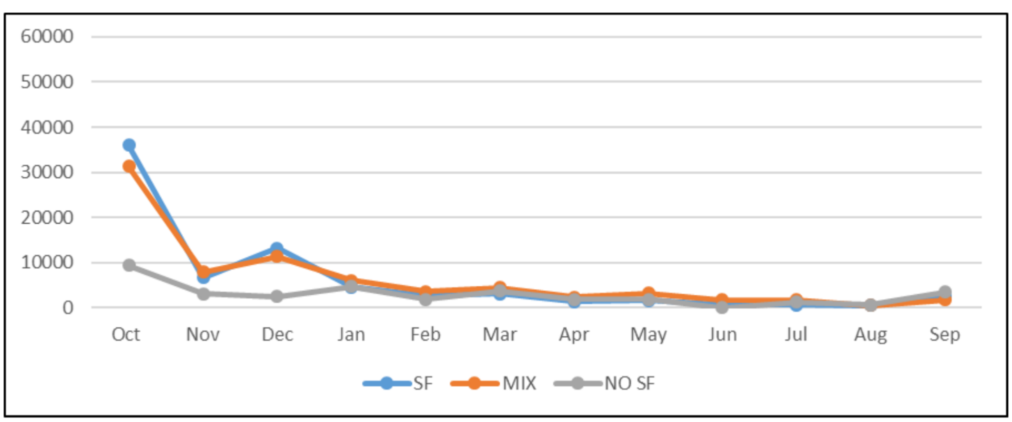

Figure 2. Spot Market Bushels sold by month

We estimate two models, each estimated by month containing a large number of variables. Thus, we present only partial marginal effects important to our hypothesis about the influence of SF preferences on grain marketing decisions. Table 1 displays the role of SF risk preferences for both models across the first six months of the storage period (October-March). The estimated relation between SF risk preferences and the number of bushels sold is insignificant for each month except for February (at 10% significance). For February we find a positive relation, indicating those with SF risk preferences sell 4% more than those without SF risk preferences. For the months not shown, no significant results were found between SF and bushels sold. Moving to the percent of bushels sold on the spot market, we find positive and significant results (at least at the 10% level of significance) for the first three months of the storage period. In October, SF risk preferences sold 18% more than those without SF risk preferences. For November and December, the difference is 4% and 11%, respectively. No significant results were found for the months not shown.

Thus, our results suggest risk preferences, specifically SF risk preferences, do indeed influence the amount of grain sold. SF risk preferences appear to impact the amount of grain sold in two ways. First, those with SF risk preferences use spot market sales more than forward contracts. We see this result from lack of significant difference in SF estimate for total bushels sold, whereas for the spot market sales, we find evidence of significant differences in the percent of bushels sold per month. Second, those with SF risk preferences sell more in the months right after harvest as is evident in the positive and significant differences in spot market bushels sold in those months.

Discussion

In this project we investigated the role of SF risk preferences in post-harvest grain marketing decisions using the experimental economic methodology within a unique context-rich grain marketing simulation game. Our findings suggest that SF risk preferences impact the decision to sell grain and that this impact comes in two ways. First, those with SF risk preferences appear to prefer cash contracts. Second, these individuals sell more grain in the months right after harvest. Both of these results appear to be reasonable given SF risk preferences whereby the person would behave in order to avert disaster. First, using cash contracts implies a cash transfer right away vs selling now for future delivery where there is the possibility of grain going out of condition and/or the elevator not being around when delivery occurs. Second, selling in the months immediately after harvest reduces net income risk as bushels are converted to dollars right away.

The results have important implications for decision making. Our results suggest that there is a segment of the population following SF risk preferences who will focus on the use of cash contracts, despite financial opportunities resulting in higher net income. Our findings established that one should not expect everyone to take advantage of all commodity marketing ideas/concepts.

The results of our study provide systematic evidence of concepts about the importance of SF risk preferences to producer decision making. However, we should exercise caution when generalizing these results given the student subject data base. External validity and generalizability of the results would require that we conduct these experiments with actual producers. Additionally, it is important to evaluate the degree to which risk preferences impact marketing decisions in the pre-harvest setting under different grain price scenarios. These are the subject matter of current ongoing research.

Table 1. Regression Results

		Month					
Dependent Variable	Parameter	October	November	December	January	February	March
Total Bushels Sold							
	Safety First	-0.14	-0.04	0.05	-0.01	0.04*	0.001
		(0.16)	(0.09)	(0.04)	(0.06)	(0.02)	(0.03)
Total Bushels Sold on Spot Market							
	Safety First	0.18**	0.04*	0.11***	0.03	0.02	0.02
		(0.08)	(0.02)	(0.03)	(0.03)	(0.01)	(0.02)

Note: Standard errors in the parenthesis. Statistical significance is denoted by *, ** and *** for 0.01, 0.05,and 0.10 levels, respectively.

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