THE VALUE OF OUTLOOK INFORMATION IN POST-HARVEST MARKETING STRATEGIES

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ABSTRACT

This paper uses stochastic dominance theory to evaluate the use of market outlook information in the harvest decision to store or not store grain sorghum in the Coastal Bend region of southern Texas. Use of Pratt risk-aversion coefficients to identify various classes of decision makers lead to the conclusion that outlook information is valuable to a variety of decision makers.

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Advances in decison theory (i.e., stochastic dominance with respect to a function) make it possible to use probabilistic market information to evaluate alternative marketing strategies. Further, comparing strategies that use outlook information to those which do not, allows for an evaluation of outlook information. This paper illustrates a methodology for such an evaluation using historical (1972-81) grain sorghum prices for the Coastal Bend region of southern Texas. Although this illustration is limited to a specific location and to the basic decision of whether or not to store at harvest, the methodology could be expanded to any region and to include any combination of marketing decisions involving cash sales, forward contracts, or hedging in the futures markets.

A major problem of marketing is one of assessing the tradeoffs between returns and risks associated with alternative strategies. Since the mid-1972 Soviet grain deal, grain markets have become much more volatile. Therefore, the problem of developing appropriate marketing strategies has increased. Although economists continue their involvement with traditional forms of market information (i.e., forecast of price movements), probabilistic market information (PMI) holds some promise for supplementing these approaches. Ikerd, Nelson, and Black and Dike are among the current supporters for the preparation and delivery of PMI to producers. One approach to developing PMI uses historical data to develop the objective probability distribution for the desired measurement variable (in this case, the net returns to storage for months after harvest). Thus, an accounting of the risk and return tradeoffs associated with alternative marketing strategies can begin.

Focusing on only returns to storage for months after harvest simplifies the presentation of the methodology. The first task involves development of meaningful returns to storage for each month after harvest. As will be demonstrated, this task is complicated by the rapid rates of inflation over the 1972-81 period. Recognizing that the degree of variability of these storage returns affects producers'

marketing decisions and assuming that such variability reflects fundamental market conditions, objective probability distributions are then developed for several possible post-harvest marketing strategies. Subjective interpretations of market outlook information from a variety of sources are used to develop recommendations concerning the "store/do not store" decision at harvest. This information is used to develop objective probability distributions for marketing strategies in which the producer follows and does not follow the market outlook information. Finally, stochastic dominance theory is used in conjunction with several classes of decision makers (i.e., based on their aversion to risk) to rank the marketing alternatives and assess the value of market outlook information.

Developing Normalized Returns to Storage

Recent attempts to evaluate crop marketing strategies by Purcell, Ferris, and Shane and Myer utilized historical price patterns in calculating returns to storage and post-harvest sales. In this analysis, July was designated as the harvest month for grain sorghum in the Coastal Bend of Texas. All returns to post-harvest sales strategies are therefore calculated with respect to the July monthly average price. It is recognized that using monthly average prices tends to obscure some of the seasonal price variability. However, these errors should average out over time.

A number of economic principles were applied in the development of normalized returns of storage. These general cost considerations associated with a storage decision are: 1) cash storage costs; 2) opportunity costs; and 3) physical storage loss. In addition, since price inflation persisted through 1972-81, it was necessary to normalize returns into August 1981 dollars.

This study considers only a commercial storage option. Annual fixed handling costs and monthly storage costs were developed through conversations with Campbell, King, and Lippke (Fall 1981). Opportunity costs were developed using

the annual Production Credit Association's interest rates for the Coastal Bend region to discount the net price received from the post-harvest sales strategy into harvest-time dollars. By not selling at harvest-time, it is assumed that a producer foregoes the opportunity to pay off existing loans. Discounts are also provided to account for physical storage losses that result from increased handling and additional aeration during the storage period. The equations used to perform the calculations for the nominal net returns to post-harvest sale of grain sorghum, as opposed to a harvest-time sale, are as follows:

$$NR_{ij} = \{[(P_{PH_i} - ASC_i) * AW_i] * DF_i\} - P_{H_j} \quad \text{(Equation 1)}$$

with

$$ASC_i = [FSC + (M*SC)] * [1.0 - IL] \quad \text{(Equation 2)}$$

$$AW_i = [1.0 - IL - (TM*ML)] \quad \text{(Equation 3)}$$

$$DF_i = (1.0 + r)^{-TM/12} \quad \text{(Equation 4)}$$

where

NR_{ij}: net returns associated with a post-harvest sales strategy in month i as opposed to a harvest-time sales strategy in month j ($/cwt.);

P_{PH_i}: post-harvest sales price in month i ($/cwt.);

ASC_i: adjusted storage costs associated with a post-harvest sales strategy in month i - assumes costs are paid at post-harvest sales date ($/cwt.);

AW_i: adjusted weight associated with a post-harvest sales strategy in month i (fraction of one cwt.);

DF_i: discount factor associated with a post-harvest sales strategy in month i;

P_{H_j}: harvest-time sales price in month j ($/cwt.);

FSC: Fixed Storage costs ($/cwt.);

M: number of months stored past harvest time for which storage costs are assessed;

SC: monthly storage cost ($/cwt.);

IL: initial physical storage loss (% x .01);

ML: monthly physical storage loss (% x .01);

r: effective discount interest rate (% x .01);

TM: total number of months stored from harvest-time to post-harvest sales date.

The NR_{ij}'s calculated as shown above are stated in terms of harvest-time dollars, facilitating comparison of alternative post-harvest sales strategies (are returns above costs greater for sales in January or May?) as well as for evaluating the returns of any one post-harvest sales strategy above harvest-time sales.

The nominal NR_{ij}'s calculated for different years of the data series will have differing levels of purchasing power due to inflation. In order to facilitate comparison of such returns across years on an equivalent basis, the following adjustments were made in terms of nominal August, 1981 dollars:

$$ANR_{ijk} = NR_{ijk} \times \frac{151}{IPP_k} \qquad \text{(Equation 5)}$$

where

ANR_{ijk}: net returns associated with a post-harvest sales strategy in month i as opposed to a harvest time sales strategy in month j of year k adjusted to August, 1981 dollars ($/cwt.);

NR_{ijk}: nominal net returns associated with a post-harvest sales strategy in month i as opposed to a harvest-time sales strategy in month j of year k ($/cwt.);

151: Index of Prices Paid by Farmers for commodities & services, interest, taxes & wage rates for August, 1981 (1977 - 100);

IPP_k: Index of Prices Paid by Farmers for commodities & services, interest, taxes and wage rates for year k (1977 = 100).

Table 1 provides the results of normalizing the data with Equations 1-5 above. The individual net returns identified therein are those which would be realized on a per hundredweight basis if a producer were to delay sale of his grain sorghum beyond harvest-time in July to each of the designated post-harvest months. These

Table 1. Normalized Returns to Post-Harvest Storage ($ per cwt.) for Grain Sorghum in the Texas Coastal Bend Region (1972-1981).*

STORAGE YEAR	SALES MONTH										
	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DECEMBER	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE
	($/CWT.)										
1972-73	0.14	0.47	0.37	0.44	1.78	2.21	1.85	1.58	1.13	1.24	2.18
1973-74	1.17	0.85	0.81	0.41	0.57	1.41	1.59	1.13	-0.23	-1.05	-1.37
1974-75	1.62	1.29	2.77	2.55	1.95	0.48	-0.84	-0.98	-0.81	-1.21	-2.09
1975-76	0.96	0.77	0.49	-0.10	-0.23	-0.41	-0.38	-0.47	-0.79	-1.22	-0.84
1976-77	-0.92	-0.62	-1.32	-1.77	-1.60	-1.53	-1.64	-1.91	-2.23	-2.53	-2.98
1977-78	-0.39	-0.33	-0.12	0.38	0.26	0.04	-0.00	0.22	0.61	0.45	0.31
1978-79	-0.28	-0.42	-0.21	-0.12	-0.25	-0.30	-0.34	-0.47	-0.56	-0.60	0.01
1979-80	-0.57	-0.65	-0.55	-0.65	-0.66	-1.00	-0.91	-1.21	-1.41	-1.41	-1.40
1980-81	0.36	0.20	0.12	0.26	0.02	-0.04	-0.52	-0.67	-0.89	-1.23	-1.51
MEAN	0.2346	0.1759	0.2635	0.1544	0.2038	0.0949	-0.1324	-0.3099	-0.5740	-0.8401	-0.855
STD. DEV.	0.8631	0.7113	1.1302	1.1426	1.1223	1.1516	1.1471	1.1155	1.0045	1.1012	1.516
COEF. VAR.	3.6787	4.0440	4.2885	7.4007	5.5081	12.1403	-8.6626	-3.5994	-1.7500	-1.3109	-1.771

* Harvest month for grain sorghum in the Texas Coastal region is July. Returns are net above commercial storage costs and opportunity costs and are normalized into August, 1981 dollars for grain sorghum stored from harvest until the respective sales month.

results indicate that, on the average, net returns to storage are positive (greater than harvest-time income) for post-harvest months August through January and negative (less than harvest-time income) for months thereafter. However, the statistical measure of standard deviation suggests that the net returns are quite variable. This variability is more readily apparent in the calculated coefficient of variation. As expected, this variability also increases away from harvest until the negative mean returns are encountered.

Subjective Interpretation of Available Outlook Information

Grain sorghum producers in the Coastal Bend region of Texas have at least four sources of outlook information readily available to them in June and early July during which time they are contemplating the "store/do not store" decision: Progressive Farmer, Farm Journal, Doane's Agricultural Report and Feed Situation (USDA). The results of reviewing and subjectively interpreting the general outlook information and/or recommendation provided by these sources during the 1972-1980 period are as follows: 1) store in crop year 1972 and 1973; 2) do not store in 1974-1977; and 3) store in 1978-1980.

The subjective judgement approach to assessing a general recommendation of "store/do not store" for each of the respective year's harvest period was based on interpreting only the information available at that time -- current carryover of feed grains, forecast of crop size, relative prices among feed grains, anticipated domestic usage and forecast of export demand. A consensus of opinion was arrived at by comparing individuals' personal interpretations of the available information. It is recognized that other individuals could possibly otherwise interpret the marketing signals provided by these sources.

Developing Cumulative Distributions for Alternative Strategies

Once the normalized net returns and the subjective storage recommendations were developed, the next task involved developing the returns for each year, given specified marketing strategies. This data, in turn, is used to develop

cumulative distributions that are used, as described below, for stochastic dominance analysis. Table 2 presents the primary statistical parameters of selected post-harvest marketing strategies. There are two sub-groups provided: 1) strategies that do not use the market information, and 2) strategies that use the market information. Strategies in sub-group 2 are broken down further to include: a) a strategy that explicitly FOLLOWS the outlook information and stores only in years when the recommendation is to store, and b) a strategy that involves a completely CONTRARY approach and stores only in years when the recommendation was not to store. Under these approaches, an annual return to storage of zero was used in the years when grain was not stored at harvest.

Table 2 clearly demonstrates the return and risk trade-off associated with alternative strategies that either use the market outlook information or do not use it. This also makes it clear that a prescription of a "best" post-harvest marketing strategy for an individual grain sorghum producer in the Coastal Bend of Texas will be contingent upon his risk preferences. Thus, the issue becomes one of ranking the strategies, given producer risk preferences.

Ranking the Strategies

Representations of the cumulative distribution function of net returns associated with each strategy were developed from the nine years of the study period (Anderson, et al., Barnett). Such cumulative distribution functions can be ordered by application of stochastic dominance with respect to a function (Meyer; Danok, et al.; King and Robison). Through use of Pratt risk-aversion parameters, this methodology allows for the selection of efficient sets of marketing strategies for producers with different risk-preference characteristics. In this analysis, eight classes of decision makers' risk-aversion parameters are considered: 1) -0.1000 to 0.1000, approximately First Degree Stochastic Dominance (more income is preferred to less), 2) 0.0000 to 0.1000, approximately Second Degree Stochastic Dominance (at higher levels of income, less variability is preferred to more), 3) -0.1000 to 0.0000, representing a highly risk-loving decision maker (at higher

Table 2. Statistical Parameters of Selected Post-Harvest Marketing Strategies for Grain Sorghum in the Texas Coastal Bend Region (1972-1981).

Strategy	Mean ($/cwt.)	Standard Deviation	Coefficient of Variation
Sub-Group 1: Does not use Market Outlook Information			
1. Sell all at harvest	0.0	0.0	∞
2. Sell 1/12 ea. month, beginning in July	-0.132	0.788	-5.969
3. Sell ¼ in July, Oct, Jan & April	-0.054	0.687	-12.722
4. Sell 1/3 in July, Oct & Jan	0.120	0.666	5.550
5. Sell ½ in July & Aug	0.117	0.431	3.683
6. Sell ½ in July & Oct	0.066	0.623	9.439
7. Sell ½ in July & Dec	0.102	0.562	5.509
8. Sell ½ in July & Jan	0.047	0.573	12.191
9. Sell ½ in July & Feb	-0.065	0.573	-8.815
Sub-Group 2: Use of Market Outlook Information[1/]			
10. FOLLOWS, Sell 1/12 ea. month	0.007	0.547	78.142
11. CONTRARY, Sell 1/12 ea. month	-0.140	0.564	-4.028
12. FOLLOWS, Sell ¼ in July, Oct, Jan and April	0.024	0.470	19.583
13. CONTRARY, Sell ¼ in July, Oct, Jan and April	-0.078	0.497	-6.371
14. FOLLOWS, Sell 1/3 in July, Oct and Jan	0.104	0.431	4.144
15. CONTRARY, Sell 1/3 in July, Oct and Jan	0.015	0.511	34.066
16. FOLLOWS, Sell in Aug	0.091	0.480	5.274
17. CONTRARY, Sell in Aug	0.141	0.738	5.234
18. FOLLOWS, Sell in Oct	0.060	0.374	6.233
19. CONTRARY, Sell in Oct	0.202	1.078	5.336
20. FOLLOWS, Sell in Dec	0.162	0.685	4.228
21. CONTRARY, Sell in Dec	0.042	0.899	21.404
22. FOLLOWS, Sell in Jan	0.253	0.960	3.794
23. CONTRARY, Sell in Jan	-0.157	0.560	-3.566
24. FOLLOWS, Sell in Feb	0.185	0.925	5.000
25. CONTRARY, Sell in Feb	-0.317	0.573	-1.807

1/ FOLLOWS - Indicates storage only in those years that the forecast suggests storage.
CONTRARY - Indicates storage only in those years that the forecast suggests not to store.

levels of income, more variability is preferred to less), 4) -0.0400 to -0.0300, representing a moderate risk-loving decision maker, 5) 0.0000 to 0.0000, representing a risk neutral decision maker, 6) -0.0001 to 0.0001, representing a low, almost risk-neutral, level of absolute risk aversion, 7) 0.0001 to 0.0003, representing a moderately risk-averse decision maker and 8) 0.0003 to 0.1000, representing a high absolute level of risk-aversion (King and Oamek). These several levels of risk-aversion parameters are meant to represent risk aversion coefficients for different groups of grain producers, varying from risk avoiders to risk lovers.

A modified version of a Fortran software package developed by Richardson was used to conduct the stochastic dominance analysis. A detailed mathematical description of stochastic dominance can be found in Anderson, et al.; King and Robison; and Kramer and Pope.

Table 3 provides the stochastic dominance results from all strategies. Results indicate that First Degree and Second Degree stochastic dominance are unable to identify a manageable set of strategies to choose among. However, stochastic dominance analysis for the remaining pairs of Pratt risk aversion parameters indicates that specific efficient sets of market strategies can be identified as efficient for an individual or a group of decision makers according to their risk preferences.

Measuring the Value of Outlook Information

Finally, the results presented in Table 3 can be used to evaluate the value of the market outlook information. For three classes of decision makers, strategy #22 (i.e., store only when the forecast suggests storage and sell all of the grain in January) dominates all other strategies. Further, this strategy is efficient in all classes expect for the risk-lover group. This suggests the market outlook information is valuable. The inclusion of strategy #19 is efficient for the risk-loving decision groups (i.e., parameters - .10 to .10 and -.04 to -.03).

Table 3. Stochastic Dominance Results: All Strategies*

Strategy	Risk Aversion Coefficients: -.1000 to .1000	.0000 to .1000	-.1000 to .0000	.0000 to .0000	-.0400 to -.0300	-.0001 to .0001	.0001 to .0003	.0003 to .1000
1. Sell all at harvest	✓	✓						✓
2. Sell 1/12 each month, beginning in July	✓							
3. Sell ¼ in July, Oct, Jan & April	✓							
4. Sell 1/3 in July, Oct & Jan	✓	✓						
5. Sell ½ in July & Aug	✓	✓						✓
6. Sell ½ in July & Oct	✓							
7. Sell ½ in July & Dec	✓							
8. Sell ½ in July & Jan	✓							
9. Sell ½ in July & Feb								
10. STORE, Sell 1/12 each month								
11. NOT STORE, Sell 1/12 each month								
12. STORE, Sell ¼ in July, Oct, Jan & April								
13. NOT STORE, Sell ¼ in July, Oct, Jan & April								
14. STORE, Sell 1/3 in July, Oct & Jan	✓	✓						✓
15. NOT STORE, Sell 1/3 in July, Oct & Jan	✓							
16. STORE, Sell in Aug	✓							
17. NOT STORE, Sell in Aug	✓							
18. STORE, Sell in Oct	✓	✓						✓
19. NOT STORE, Sell in Oct	✓		✓		✓			
20. STORE, Sell in Dec	✓	✓						✓
21. NOT STORE, Sell in Dec								
22. STORE, Sell in Jan	✓	✓	✓	✓		✓	✓	✓
23. NOT STORE, Sell in Jan								
24. STORE, Sell in Feb	✓	✓						
25. NOT STORE, Sell in Feb								

*For each respective pair of risk aversion coefficients, those strategies which are checked comprise the efficient or dominating set of strategies. The unchecked strategies are, therefore, to be interpreted as being inferior to the efficient set.

This suggests that these groups of decision makers may actually prefer to use the outlook information in a "contrary" fashion (i.e., store only in those years when the forecast suggests no storage and sell all stored grain in October).

Conclusions

This paper demonstrates an approach for normalizing monthly net returns to storage and then using these values to develop representative cumulative distributions of annual returns to storage under alternative post-harvest marketing strategies. Stochastic dominance is then used to develop the efficient strategies for various classes of decision makers. Although only a limited number of strategies were evaluated, the approach could be expanded to include more strategies and/or different crops from different regions. Producers should find the type of information presented here complementary to traditional forms of market information (i.e., forecasts).

A major contribution of this paper involves the beginning attempts to evaluate market outlook information. By comparing strategies that make use of market outlook information with those that do not, inferences were developed concerning the value of the information. The results presented do suggest that the various sources of market information analyzed in this study are valuable to Texas Coastal Bend grain sorghum producers.

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