A Risk Analysis of Marketing Strategies Available to Nebraska's Soybean Producer

by

Charles Curtis, Lynn Lutgen, George Pfeiffer,

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Price fluctuations in agricultural commodity markets have increased substantially since 1972-73. This increase in volatility opened a pandora's box for producers. Since 1972, real prices (1983=100) for soybeans at harvest (as measured by the first Thursday in November closing price of the January Chicago Board of Trade contract) have fluctuated from a high of $15.06 per bushel in 1974 to a low of $5.69 per bushel in 1982 [Chicago Board of Trade].

The old marketing rules of thumb followed year in and year out were often found to achieve inferior results relative to other available market risk management techniques. Simply identifying the various marketing alternatives annually available to the farmer and estimating the resulting gross income generated is a monumental task. To compound matters, any individual marketing alternative in any single year could return the greatest (or most inferior) level of revenues in comparison to all other available strategies.

Consideration of the variation in returns generated by a marketing strategy through time is of importance to the entrepreneur. The potential for increased income and risk reduction from diversification or mixing of marketing alternatives should also be explored.

The purpose of this paper was to examine some of the strategies that were consistently available to the Nebraska soybean producer during the 1978 to 1983 crop years. Particular attention was paid to the variation associated

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with the returns these strategies generated. The approach of this paper is to identify and evaluate dominant portfolios of soybean marketing strategies at various levels of risk.

The specific study objectives were as follows:

1.) To identify a plausible set of soybean marketing strategies available to Nebraska producers and evaluate their expected real returns and distribution of returns over time (1978 to 1983);

2.) To develop risk-efficient portfolios of the strategies with risk defined as the occurrence of actual returns falling below a targeted return level.

Inclusion of an income variation criterion adds information beneficial to the marketing strategy selection process. This additional information allows for the reduction of the general set of alternative strategies to a smaller set of risk-efficient mixes. This, in turn, fosters a reduction in the complexity of the marketing decisions confronting the producer.

Some Theoretical Considerations

Risk has historically been defined as a deviation of realized economic returns from those expected [Markowitz; Hey]. Ceteris paribus, there is assumed to be a positive relationship between risk and expected income for most economic activities. In other words, a higher level of risk will only be accepted if accompanied by the expectation of a higher level of income.

Since the economic outcome of an activity is not certain, the term "expected" is used in conjunction with the anticipated returns. The expected income of activity n, $E(I_n)$, is assumed to be the sample mean of returns generated by activity n over the study period.

There have been many specifications of risk presented in the literature of decision theory [Barry; Selley]. Three potential specifications are the mean-variance (EV), mean-absolute deviation (MAD), and absolute negative target deviation (ANTD) measures of risk.

The EV and MAD specifications measure risk by summing the deviations of actual returns from average returns in previous states of the world. A principal difference between these risk measures is that the non-linear EV measure places significantly greater weight on large deviations.

A producer facing risk (as defined by EV or MAD) is assumed to maximize utility (U) generated from all activities entered. Utility is defined to be a function of both income (I) and risk (R). Thus, for any activity n:

$$(1)\ U_n = f[E(I_n), R_n] = a + b[E(I_n)] - c(R_n)$$

The first partial derivative with respect to the income parameter is assumed positive. The first partial derivative with respect to the risk parameter is assumed negative which implies a reduction in utility is suffered from increasing levels of risk, ceteris paribus. This is consistent with the classic properties suggested by the Von Neumann-Morgenstern (1947) risk averse utility function. The magnitude of the risk parameter coefficient (c) indicates the specific level of risk aversion associated with any individual producer.

Producers have the ability to combine two or more marketing activities in some proportion to form portfolios. If only two activities (n and m) are available, the producer could form at least two portfolios, Pa and Pb, as follows:

$$(2)\ Pa = [x(n) + 1-x(m)]$$

$$(3)\ Pb = [y(n) + 1-y(m)];\ y \neq x$$

where x is the percent of portfolio A and y the proportion of portfolio B made up by activity n; $y \neq x$ assures different portfolios. Note that this does not exclude the possibility of a single activity portfolio. The risk associated with a portfolio of activities considers the correlation of the activities' returns. If the correlation between the activities is negative there is a risk abatement advantage to diversification. Portfolio A would dominate portfolio B if and only if:

(4) $E(I_{Pa}) \geq E(I_{Pb})$; and

$R_{Pa} \leq R_{Pb}$

with at least one strict inequality.

A major criticism of the mean-variance and mean-absolute deviation approaches to risk measurement is the possible inappropriateness of risk measured as deviations (positive or negative) from the mean (average return). If risk is measured as any deviation from average income then any actual return in which income is greater than expected would be considered risky. An activity may be severely penalized by strongly out performing its average in one state of the world and being close to its expectations in all other considered states of the world. Many have considered including positive deviations as "risk" as inappropriate [Hazell].

The semivariance (SV) specification was suggested by Markowitz (1959) as a theoretical correction for some of the flaws in the EV risk measure. Risk was redefined as the summation of squared deviations below mean income. The semivariance approach asserts that a producer is risk averse to returns below expected income and risk neutral if returns are above those expected. This eliminates the inclusion of returns above expectations in the risk measure.

An additional attribute of a "downside" risk measure such as SV is that it does not mandate the use of average income as the base from which deviations are calculated. Use of the average return as the reference point may not be preferred because expected incomes vary across activities.

Summing the absolute value of the negative deviations below a target (ANTD) provides a linear approximation of the non-linear semivariance measure. Utilizing the ANTD measure of risk allows the use of linear optimization techniques.

Watts, Held, and Helmers (1984) point out that measuring risk as absolute negative deviations from a target level of income standardizes the risk reference point across all considered activities. This, in turn, allows for an increased discrimination among the alternative portfolios. As a result, this risk measure should identify a smaller set of preferred alternatives which reduces the complexity of the decision process. Tauer (1983) presents proof that portfolios developed using ANTD as a risk criteria are a subset of the second-degree stochastic dominant set.

Risk (R-) associated with any activity n, using the ANTD measure, is expressed as follows:

$$(5)\quad R_n- = 1/s \sum_{q=1}^{s} |[I_{nq} - T]| \text{ for } I_{nq} < T\text{; and}$$
$$= 0 \qquad \text{for } I_{nq} \geq T.$$

Where s is the number of states of the world being considered; I_{nq} is the actual income generated from activity n in state of the world q; and T is the target income (or survival level of income) from which deviations are measured.

The definition of producer utility associated with activity n under ANTD is expressed as:

$$(6)\quad U_n = f[E(I_n), R_n-]$$
$$= a + b[E(I_n)] - c(R_n-) \text{ for } E(I_{nq}) < T.$$
$$= a + b[E(I_n)] \qquad \text{for } E(I_{nq}) \geq T.$$

Portfolio A would dominate portfolio B if and only if:

$$(7)\quad E(I_{Pa}) \geq E(I_{Pb})\text{; and}$$
$$R_{Pa}- \leq R_{Pb}-$$

with at least one strict inequality, which would then imply greater utility associated with Pa as defined in (6).

The Target MOTAD Model

Target MOTAD was employed to determine risk-efficient (as measured by absolute negative target deviations) portfolios of marketing strategies. The statistical properties and operational characteristics of the Target MOTAD model have only recently been explored. The model discussed herein is a blend of the concepts described by Tauer (1983) and Watts, Held, and Helmers (1984).

Target MOTAD maximizes expected income subject to a given level of absolute negative deviations of actual income below a fixed target and resource constraints. The pertinent utility function would be the function expressed by equation (6).

The Target MOTAD linear programming model can be expressed as:

Maximize: (8) rx

subject to: (9) $Ax \geq \text{ or } \leq b$

(10) $(R - T)x + Iy- \geq 0$

(11) $vy- = D$

(12) $x, y- \geq 0$

where: v = a 1 by s vector in which each element is "1/s" where s is the number of considered states of the world;

A = an m by n matrix of technical coefficients, where m is the number of constraints and n is the number of activities considered;

x = an n by 1 vector of activities;

b = an m by 1 vector of resource constraints;

$y-$ = an s by 1 vector of negative income deviations below the fixed income target;

D = A scalar representing average deviations below the fixed income target;

r = a 1 by n vector of expected income for each activity;

T = an s by n matrix in which all elements are the fixed income target;

R = an s by n matrix of actual income for all activities for the s states of the world considered;

I = an s by s identity matrix;

0 = a column vector of appropriate length (s or n), composed of zeros.

Target MOTAD efficient frontiers are developed by parametrically varying deviations (D) from levels associated with the LP solution to zero. Risk-efficient frontiers can be developed for various fixed targets allowing for differences across firms in returns required for long-run survival.

For each target, a risk-efficient frontier can be developed for optimal (maximum expected returns) solutions over a range of expected deviations. A frontier of optimal marketing plans is derived to generalize the portfolio selection process. The specific marketing portfolio employed by any one producer will depend on the nature of the individual's income and risk preferences. The selected portfolio is assumed to be tangent to the highest obtainable iso-utility curve of the producer.

Soybean Marketing Strategies Examined

Four general approaches to marketing soybeans were established; unhedged cash sales, static hedging, "cost plus" hedging on a price objective, and selective hedging on technicals. These groups were emphasized because of their relative simplicity. It was felt that a producer could easily employ these marketing approaches. Curtis (1985) presents these marketing strategies and their associated income and variation characteristics in much greater detail.

Several strategies were identified within each of the four groups; 103 strategies were examined overall. The major difference between alternatives within each group was the timing of the pricing and exchange activities.

Gross prices were determined for all strategies examined over the study period from Chicago Board of Trade price series. The gross price was adjusted for costs of storage (if any) including interest on the value of the unsold grain. A commission charge was subtracted from any hedging strategy's returns for each round turn. Price received was increased (reduced) for trading profit (loss) if the strategy required multiple round turns within any one marketing year. All strategies were adjusted to reflect the prevailing Nebraska basis at time of sale. Average monthly cash price received for soybeans in Nebraska less the monthly average futures price on the nearby contract was used to proxy the basis at transaction.

The cash sale strategies (1-4) assumed that the producer priced the crop on a particular date each year. Strategy number one, for example, required that the producer sell at harvest every year. The gross price received under this alternative was the closing price observed on the first Thursday in November on the January CBT soybean contract. The net price received was this price minus the expected local basis. Alternatives in this group that stored soybeans did so unhedged.

The static hedging group (5-22) assumed that the commodity was priced (short hedge placed) every year at the same time regardless of near-future price expectations. Subsequently, the hedge is lifted and the crop exchanged at some later date. Strategy seven required, for example, that a short hedge be placed in May (around planting) and held until the crop is sold the first week in November (harvest).

The "cost plus" strategies (23-48) required the producer to place a hedge if an objective price is observed at the market. Hedging at a price equal to or greater than the objective price assures that the net price received will cover production cost, a return to management (profit), and a differential for the local basis. The producer would remain unhedged if the price objective is not observed by the sale (or termination) date.

The alternatives involving selective hedging on technical factors (49-103) required the multiple placing and lifting of hedges depending on the relative magnitudes of a pair of weekly moving averages. This approach is more speculative in the sense that a producer may, at times, hold a long cash position with no offsetting futures position. Unhedged cash sales from storage are, of course, always speculative under this definition.

Table 1 displays the returns in 1983 dollars, net of marketing costs and basis, and the standard deviations of the strategies examined over the study period. The first month in the strategy description refers to the starting date, the second month the date of strategy termination. Year "t" refers to the year in which harvest takes place. The 10% and 30% associated with the "cost plus" strategies refer to the level of profit (as a percent of production costs) added to the price objective. The length of the weekly moving averages associated with the technical strategies are indicated as 3 & 5, 3 & 10, 3 & 15, 5 & 10, and 5 & 15.

An Application of Target MOTAD to Producer Marketing

A schematic of the Target MOTAD matrix used to derive efficient portfolios of soybean marketing strategies is displayed in Table 2. The objective function of this model is to maximize expected income from marketing over the years considered.

The activity columns may be divided into two groups. The "Marketing Strategy # N" columns are required for the N (103) marketing activities available to the firm. The "Deviations Year # S" columns account for the deviations below the target over the S (6) years in the study period.

The first constraint rows represent specific years of the study period. The technical coefficient, "Asn", represents the residual of actual returns per bushel from strategy N in year S from the target return (Asn = Rsn - T).

Table 1. Sample Means and Standard Deviations of Per Bushel Returns from Examined Marketing Strategies, Real (1983) Dollars; 1978 to 1983.

Marketing Strategy Number		Marketing Strategy Description		1978-83 Average Price	1978-83 Standard Deviation
				----(1983	$/bu)----
I	1	Cash sale, November t		$7.42	$1.61
	2	Cash sale, January t+1		$7.09	$1.55
	3	Cash sale, March t+1		$6.79	$1.58
	4	Cash sale, May t+1		$6.76	$1.31
II	5	Jan. t for Nov. t		$7.00	$1.10
	6	March t for Nov. t		$6.97	$1.06
	7	May t for Nov. t		$7.11	$1.05
	8	July t for Nov. t		$7.19	$1.26
	9	Jan. t for Jan. t+1		$6.75	$1.04
	10	March t for Jan. t+1		$6.76	$1.03
	11	May t for Jan. t+1		$6.87	$1.04
	12	July t for Jan. t+1		$6.97	$1.22
	13	Nov. t for Jan. t+1		$7.29	$1.58
	14	March t for March t+1		$7.00	$1.08
	15	May t for March t+1		$7.12	$0.92
	16	July t for March t+1		$7.23	$1.27
	17	Nov. t for March t+1		$7.61	$1.91
	18	Jan. t+1 for March t+1		$7.01	$1.54
	19	May t for May t+1		$6.97	$1.00
	20	July t for May t+1		$7.08	$1.21
	21	Nov. t for May t+1		$7.49	$1.77
	22	Jan. t+1 for May t+1		$6.94	$1.46
III	23	Jan. t for Nov. t;	10%	$7.15	$0.81
	24	March t for Nov. t;	10%	$7.10	$0.86
	25	May t for Nov. t;	10%	$7.20	$0.94
	26	July t for Nov. t;	10%	$7.17	$1.37
	27	Jan. t for Nov. t;	30%	$7.11	$1.11
	28	March t for Nov. t;	30%	$7.08	$1.12
	29	May t for Nov. t;	30%	$7.27	$1.21
	30	July t for Nov. t;	30%	$7.28	$1.34
	31	Jan. t for Jan. t+1;	10%	$6.82	$0.89
	32	March t for Jan. t+1;	10%	$6.82	$0.96
	33	May t for Jan. t+1;	10%	$6.80	$1.26
	34	July t for Jan. t+1;	10%	$6.69	$1.22
	35	Jan. t for Jan. t+1;	30%	$6.97	$1.03

Table 1. (continued)

	Marketing Strategy Number	Marketing Strategy Description		1978-83 Average Price	1978-83 Standard Deviation
				----(1983 $/bu)----	
	36	March t for Jan. t+1;	30%	$6.80	$1.07
	37	May t for Jan. t+1;	30%	$6.81	$1.21
	38	July t for Jan. t+1;	30%	$6.98	$1.30
	39	March t for March t+1;	10%	$7.03	$1.11
	40	May t for March t+1;	10%	$6.95	$1.21
	41	July t for March t+1;	10%	$7.23	$1.27
	42	March t for March t+1;	30%	$7.04	$1.21
	43	May t for March t+1;	30%	$7.03	$1.20
	44	July t for March t+1;	30%	$7.21	$1.40
	45	May t for May t+1;	10%	$6.97	$1.00
	46	July t for May t+1;	10%	$7.08	$1.21
	47	May t for May t+1;	30%	$6.96	$1.05
	48	July t for May t+1;	30%	$7.15	$1.15
IV	49	March t for Nov. t;	3 & 5	$7.41	$0.60
	50	March t for Nov. t;	3 & 10	$7.40	$1.09
	51	March t for Nov. t;	3 & 15	$7.55	$1.38
	52	March t for Nov. t;	5 & 10	$7.29	$1.44
	53	March t for Nov. t;	5 & 15	$7.44	$1.45
	54	May t for Nov. t;	3 & 5	$7.25	$1.20
	55	May t for Nov. t;	3 & 10	$7.69	$1.09
	56	May t for Nov. t;	3 & 15	$7.12	$1.42
	57	May t for Nov. t;	5 & 10	$7.50	$1.06
	58	May t for Nov. t;	5 & 15	$7.65	$1.16
	59	July t for Nov. t;	3 & 5	$7.47	$0.90
	60	July t for Nov. t;	3 & 10	$7.70	$1.21
	61	July t for Nov. t;	3 & 15	$7.63	$1.27
	62	July t for Nov. t;	5 & 10	$7.52	$1.27
	63	July t for Nov. t;	5 & 15	$7.64	$1.28
	64	May t for Jan. t+1;	3 & 5	$6.48	$1.24
	65	May t for Jan. t+1;	3 & 10	$7.01	$1.02
	66	May t for Jan. t+1;	3 & 15	$7.27	$1.07
	67	May t for Jan. t+1;	5 & 10	$6.79	$1.21
	68	May t for Jan. t+1;	5 & 15	$6.81	$1.10
	69	July t for Jan. t+1;	3 & 5	$6.53	$1.58
	70	July t for Jan. t+1;	3 & 10	$6.77	$0.93

Table 1. (continued)

Marketing Strategy Number	Marketing Strategy Description		1978-83 Average Price	1978-83 Standard Deviation
			----(1983	$/bu)----
71	July t for Jan. t+1;	3 & 15	$6.70	$0.94
72	July t for Jan. t+1;	5 & 10	$6.59	$0.85
73	July t for Jan. t+1;	5 & 15	$6.82	$0.96
74	Nov. t for Jan. t+1;	3 & 5	$6.64	$1.26
75	Nov. t for Jan. t+1;	3 & 10	$6.34	$1.05
76	Nov. t for Jan. t+1;	3 & 15	$6.29	$1.15
77	Nov. t for Jan. t+1;	5 & 10	$6.41	$1.13
78	Nov. t for Jan. t+1;	5 & 15	$6.43	$1.16
79	July t for March t+1;	3 & 5	$6.36	$1.12
80	July t for March t+1;	3 & 10	$7.33	$1.04
81	July t for March t+1;	3 & 15	$7.33	$1.18
82	July t for March t+1;	5 & 10	$6.89	$1.35
83	July t for March t+1;	5 & 15	$7.51	$1.20
84	Nov. t for March t+1;	3 & 5	$6.48	$1.22
85	Nov. t for March t+1;	3 & 10	$6.73	$1.51
86	Nov. t for March t+1;	3 & 15	$6.74	$1.61
87	Nov. t for March t+1;	5 & 10	$7.07	$1.66
88	Nov. t for March t+1;	5 & 15	$6.89	$1.69
89	Jan. t+1 for March t+1;	3 & 5	$6.89	$1.47
90	Jan. t+1 for March t+1;	3 & 10	$6.67	$1.37
91	Jan. t+1 for March t+1;	3 & 15	$6.66	$1.44
92	Jan. t+1 for March t+1;	5 & 10	$6.70	$1.51
93	Jan. t+1 for March t+1;	5 & 15	$6.66	$1.44
94	Nov. t for May t+1;	3 & 5	$6.25	$0.98
95	Nov. t for May t+1;	3 & 10	$6.99	$0.99
96	Nov. t for May t+1;	3 & 15	$6.89	$1.41
97	Nov. t for May t+1;	5 & 10	$6.89	$1.55
98	Nov. t for May t+1;	5 & 15	$7.17	$1.29
99	Jan. t+1 for May t+1;	3 & 5	$6.47	$1.12
100	Jan. t+1 for May t+1;	3 & 10	$6.64	$1.21
101	Jan. t+1 for May t+1;	3 & 15	$6.56	$1.32
102	Jan. t+1 for May t+1;	5 & 10	$6.55	$1.43
103	Jan. t+1 for May t+1;	5 & 15	$6.66	$1.37

Table 2. Schematic of the Target MOTAD Matrix.

Row	Constraint Type	Marketing Strategy # 1	Marketing Strategy # 2	....	Marketing Strategy # N	Deviations Year # 1	Deviations Year # 2	....	Deviations Year # S	Right Hand Side
Objective Function	—	M1	M2	....	Mn					
Year # 1	G	A11	A12	....	A1n	+1				0
Year # 2	G	A21	A22	....	A2n		+1			0
|	|	|	|	....	|			....		|
Year # S	G	As1	As2	....	Asn				+1	0
Deviation Count Row	G					1/S	1/S	....	1/S	0
Bushels Sold	E	+1	+1	....	+1					100
Preharvest Sales	L		+1							60

The remaining rows, "Bushels Sold" and "Preharvest Sales", requires that bushels produced equals bushels sold and restricts preharvest sales. Requiring the "Bushels Sold" row to equal 100 bushels assures that the amount of any individual strategy found in an optimal portfolio can be interpreted as a percent of the total mix.

Marketing strategies that involve preharvest pricing were limited to no more than 60 percent of expected yields. Preharvest sales were restricted to assure that the producer was not obligated to deliver more than he actually produced in the event of adverse climatic or other environmental conditions.

Choosing Appropriate Targets

The targets in Target MOTAD are the reference points from which deviations (risk) are measured. The choice of appropriate targets is crucial when applying this technique. McCamley and Kliebenstein (1984) explored the problems associated with determining a complete set of Target MOTAD solutions. One method available would be to allow the nature of the specific economic application to dictate the number and magnitude of targets examined.

As previously suggested, an appropriate target in producer marketing would be a level of return adequate to assure the long-run survival of the firm. Several target returns should be reviewed since the specific income required to survive will vary from farm to farm. For each target explored, a model with the appropriate residuals would be needed to derive a set of optimal portfolios at various levels of expected incomes and risk. Two targets were selected for the measurement of risk associated with the marketing strategies. Targets of \$6.00 and \$7.00 were examined as levels of real returns per bushel adequate to assure a firm's long-run survival.

The 1983 costs of production (excluding returns to management) for Southeast Nebraska dryland soybeans were estimated to be \$5.35 per bushel assuming a 35 bushel yield [Jose et al., 1983]. These costs served as a base for determining appropriate targets.

Target MOTAD Results

The risk-efficient frontiers of marketing portfolios associated with the target income levels of $6.00 and $7.00 were derived via a modified version of MPS-PC; a linear programming system for the IBM personal computer [Pfeiffer, 1983]. Table 3 displays the preferred portfolios of soybean marketing strategies for the $6.00 and $7.00 targets and the associated expected incomes, average deviations below the target (expected risk), and the 1983 returns generated by these portfolios. Figures 1 and 2 present graphical representations of the Target MOTAD efficiency frontiers of the discerned marketing portfolios. The numbers along the frontiers correspond to the portfolio numbers found in Table 3.

The dominant portfolios associated with the $7.00 target included one static hedging strategy, two "cost plus" alternatives, and five selective hedging strategies. Strategy 17, placing a static hedge at harvest and lifting in March of the following year, comprised a significant proportion of all mixes in this group. It entered five of the seven portfolios at a level of 40 percent because of the preharvest sale restriction. Two of the selective hedging alternatives (49 and 95) and the "cost plus" strategies (23 and 25) were portions of the more conservative (lower risk) mixes. Selective hedging strategies 55, 58, and 60 were members of the higher expected income portfolios.

Figure 1 indicates a substantial reduction in expected risk would accompany a modest lowering of income expectations by marketing via portfolios two or three rather than one. A $0.05 per bushel increase in expected income could be gained from acceptance of an additional $0.01 in potential deviations

Table 3. Risk-Efficient Soybean Marketing Portfolios; $6.00 and $7.00 Target MOTAD Models.

Portfolio Number	Expected Income ($/bu.)	Expected Risk ($/bu.)	1983 Results ($/bu.)	Selected Strategies 17 (%)	23 (%)	25 (%)	49 (%)	55 (%)	58 (%)	60 (%)	95 (%)
Target = $7.00											
1.)	$7.67	$0.31	$7.82	40%						60%	
2.)	$7.65	$0.24	$7.34	40%					38%	22%	
3.)	$7.64	$0.23	$7.31	40%				20%	40%		
4.)	$7.57	$0.22	$7.28	40%			27%		33%		
5.)	$7.43	$0.19	$7.29	40%	20%		40%				
6.)	$7.20	$0.16	$7.00	6%	31%		29%				34%
7.)	$7.15	$0.15	$7.12	7%		35%	18%				40%
Target = $6.00											
1.)	$7.67	$0.08	$7.82	40%						60%	
2.)	$7.66	$0.05	$7.81	40%				60%			
3.)	$7.49	$0.02	$7.53	40%			60%				
4.)	$7.38	$0.00	$7.44	21%			60%				19%

Figure 1. $6.00 Target of Risk-Efficient Soybean Marketing Portfolios (1983 Dollars)

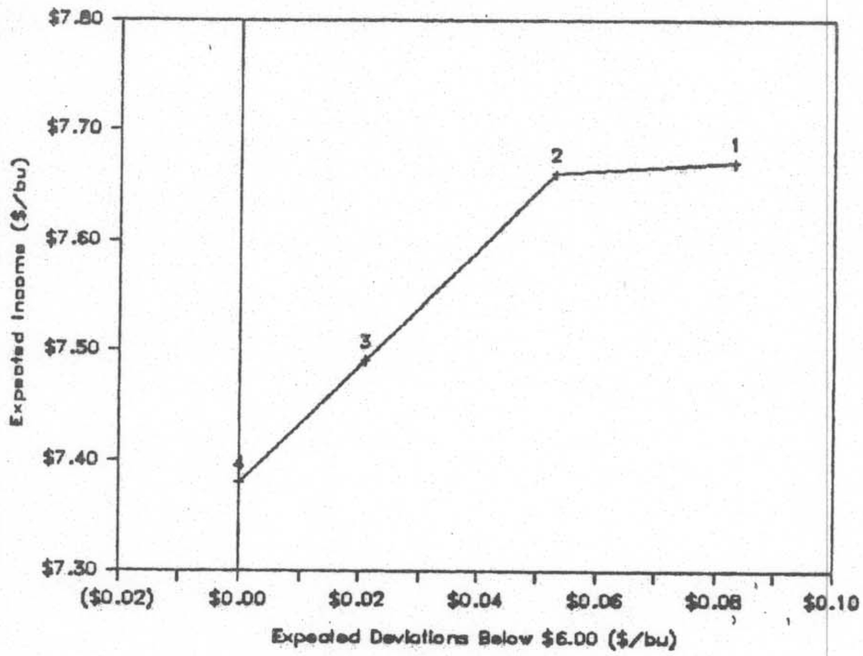
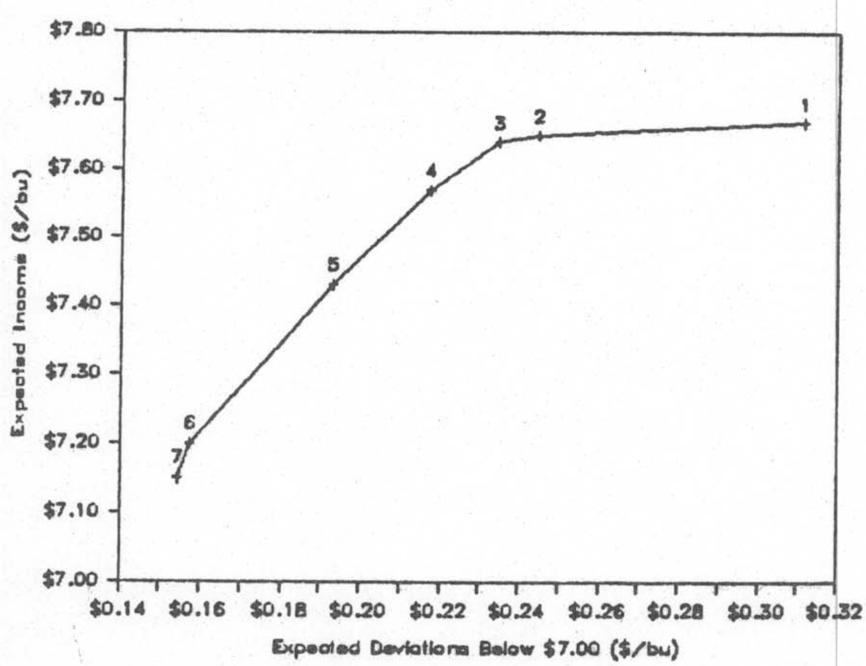


Figure 2. $7.00 Target of Risk-Efficient Soybean Marketing Portfolios (1983 Dollars)



by marketing soybeans following portfolio six instead of seven.

The results of the $6.00 Target MOTAD provide some interesting interpretations. Five strategies were active among these portfolios; strategy 17, a static hedge, and strategies 49, 55, 60, and 95 all from the selective hedging group. There was no risk of falling below $6.00 associated with portfolio four over the study period. In other words, this marketing mix produced real returns greater than $6.00 per bushel every year from 1978 to 1983. This portfolio should provide a minimum of a $0.65 return to management (given the previous cost and yield assumptions) if followed.

The 1983-84 crop year returns from the marketing strategy mixes identified as optimal by the Target MOTAD models are also presented in Table 3. The portfolios generated incomes near expectations. In general, the marketing mixes with the higher expected incomes yield higher actual returns. All strategy mixes resulted in positive returns to management.

Caution should be exercised when interpreting the performance of the identified strategies in any given year. The results of time dynamic risk analyses are best viewed as long-run results indicating optimality over a series of years. The identified portfolios may or may not be the ones that generate the highest returns for a unit of risk next year. The proper interpretation is that these should be the best portfolios, on average, from an income/risk criteria for the near future.

Two assumptions are implicit in this interpretation. First, the future will, on average, reflect similar economic conditions as the last six years. These portfolios could be sub-optimal in any year that displays economic conditions different from the historical average. Second, it was assumed that the set of strategies examined reflect a complete set. Introduction of new marketing techniques or institutional changes in the current alternatives

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