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A COMPARATIVE ANALYSIS OF OPTIMAL SOYBEAN MARKETING STRATEGIES FOR SOUTH CAROLINA FARMERS IN THE 1960'S AND THE 1970'S

Charles Curtis, Jr., Kandice H. Kahl, and Cathy S. McKinnell*

Soybean prices in the 1960's were characterized by stability near the CCC loan rate with little intra-year or inter-year variation. Reseal programs which allowed farmers in designated areas to extend farm storage loans for an additional year were used to stabilize market prices. The coefficient of variation of annual real cash prices (1983=100) for No. 2 Yellow soybeans at the Chicago market during 1962 through 1971 was 9.28 percent. Farmers' choices of marketing strategies probably were influenced heavily by the stability of prices.

The 1970's were marked by prices substantially higher than support levels with considerable variability in price from year-to-year. Rising incomes around the world stimulated demand for oilseed meals as a protein feed for expanding livestock sectors. New and expanded uses for vegetable oils helped U.S. soybean prices reach new highs. The variation of the Chicago real cash price for 1972 through 1983 rose to 23.5 percent - a substantial increase in volatility. As a result, the preferred marketing strategies (i.e., those yielding the highest obtainable incomes for given levels of risk) were most likely different from those in the previous decade.

Agricultural options began trading in the fall of 1984 after having been banished for almost 50 years. Options increase the number of marketing alternatives available to agribusiness firms. Much discussion has centered around the expectation that options afford a greater degree of price flexibility by providing a floor but not a ceiling for prices. Recently, studies by Heifner and Plato, Frank, et al., Lippke and Sporleder, and Johnson and Kenyon have explored the risk-return properties of options and, in general, found them to be a risk-efficient addition.

Soybean prices have trended downward steadily since 1983. Cash prices in many markets were at or below the effective $4.77 loan rate during the 1986 harvest. With 1986-87 ending stocks pegged at over 600 million bushels, the government loan program once again is playing an important market role. This has prompted some to suggest that the soybean market of the 1980's is returning to a "1960's market." If this is true, risk efficient portfolios of strategies based on income and risk characteristics of the 1970's may not currently be preferred. Will options and other flexible strategies be needed if there is less benefit from market flexibility in the mid-to-late 1980's?

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The purpose of this paper was to test the hypothesis that marketing strategies preferred during the 1960's by South Carolina soybean producers were different from those preferred in the 1970's. The approach was to identify and contrast optimal mixes of marketing alternatives (including the simulation of options) over three time periods; 1962-85, and two ten year sub-periods, 1962-71, and 1972-81. The performances of the portfolios preferred for the two sub-periods were tested for income and risk over the 1982-85 period. A major focus was to evaluate the contribution of options as a market risk management tool during the sub-periods. Target MOTAD was employed to identify risk-efficient mixes of the marketing alternatives.

METHODS

Simulation of Gross Revenues From Soybean Marketing

Twenty-four general strategies from seven groups of marketing alternatives were examined for possible inclusion in the optimal portfolios. These alternatives were chosen because of their relative simplicity and because they are reasonable models of alternatives most readily available to producers. See Table 1 for a complete listing. Gross revenues per acre from each of the reviewed general categories was calculated as follows:

Cash market speculative strategies - cash market sales in November or in April with no forward pricing protection,

Revenues = $(F_T + B_T - S)\ (Y_a)$, where:

T = the date of the cash market transaction (either November or April);

F = Futures price for the January contract if T is November and the May contract if T is April;

B = Basis = Cash Price - Futures Price;

S = Storage cost per bushel which is 0 if T is November and a five month storage charge if T is April; and

Y_a = Actual yield in bushels per acre

Routine hedges - placing a hedge each year in a certain month regardless of market conditions and holding the hedge until November or April when the cash market sale is made,

Revenues = $(F_p - F_1 - C)\ (Y_f) + (F_T + B_T - S)\ (Y_a)$, where:

p = the date the futures market position is placed;

1 = the date the futures market position is lifted, time T in this case

C = all charges per bushel incurred in a round turn of a futures contract;

Y_f = actual yield in bushels per acre, for harvest hedging; 60 percent of expected yield in bushels per acre, for preharvest hedging. (Expected yield is estimated as the median of actual yields during the three most recent years.)

Routine put option purchases - buying put options each year in a certain month regardless of market conditions and holding the options until November or April when the cash market sale is made,

$$\text{Revenues} = (P_1 - P_p - C)(Y_o) + (F_T + B_T - S)(Y_a), \text{ where:}$$

P = the market premium on the near-the-money option on the January futures contract if T represents November or on the May futures contract if T represents April;

C = all charges per bushel incurred in a round turn of an options contract (assumed to be the same as for a futures contract)

Y_o = actual yield in bushels per acre, for harvest put purchases; expected yield in bushels per acre, for preharvest put purchases.

Selective hedges signaled by dual moving averages - placing a hedge when a sell signal is obtained from studying three and five week moving averages and holding the hedge until November or April when the cash market sale is made,

$$\text{Revenues} = (F_p - F_1 - C)(Y_f) + (F_T + B_T - S)(Y_a)$$

Selective put option purchases signaled by dual moving averages - Buying put options when a sell signal is obtained from studying three and five week moving averages and holding the options until November or April when the cash market sale is made,

$$\text{Revenues} = (P_1 - P_p - C)(Y_o) + (F_T + B_T - S)(Y_a)$$

Multiple selective hedges signaled by dual moving averages - Placing a hedge when a sell signal is obtained from studying three and five week moving averages and liquidating the hedge when a buy signal is obtained, the placing and liquidating of hedges continuing until November or April when the cash market sale is made, with no long futures position ever held,

$$\text{Revenues} = \sum_{i=1}^{n} (F_{pi} - F_{1i} - C_i)(Y_f) + (F_T + B_T - S)(Y_a), \text{ where:}$$

i = the number of the hedge.

Options/futures market speculative strategies - selling in the cash market in November and buying a call option or buying a futures contract for liquidation in April,

Revenues = $(F_T + B_T + P_l - P_p - C)(Y_a)$ (for (7.23) in Table 1)

Revenues = $(F_T + B_T - F_p + F_l - C)(Y_a)$ (for (7.24) in Table 1)

The revenues from the various marketing strategies were calculated for each year 1962-63 through 1985-86. Strategies were compared using revenues per acre instead of prices because revenues are more important to producers. If price were the decision criterion, a producer would prefer a $6.00 price to a $5.00 price. But if the $6.00 price were associated with a yield of 25 bushels per acre and the $5.00 price with a yield of 30 bushels per acre, the producer would be indifferent between the two (assuming that total costs of production and marketing were the same).

Yield data were South Carolina state average yields obtained from Agricultural Statistics. Thursday closing futures prices were obtained from Chicago Board of Trade annuals. (Wednesday prices were used when Thursday was a holiday.) Cash prices were monthly average prices received by South Carolina farmers as reported in Agricultural Prices by USDA.

Actual option premiums were not available for the entire period of analysis, since options began trading in October 1984. Thus, option premiums were simulated using the Black model. In this analysis, all purchased option contracts were assumed to be liquidated in the option market. Thus, option profits always represented the difference between the premium received and the premium paid for the option.

Calculated option premiums were used throughout the analysis (even after actual premiums were available) to maintain a consistent comparison of the risks and revenues from option strategies for the various years. The Black model discussed in detail by Wolf was used in this analysis. In the formula, the three-month Treasury Bill interest rate was used as the risk-free interest rate and the standard deviation of prices was calculated using six weekly prices (five weekly price differences) of the underlying futures contract.

Storage costs were calculated as the costs of physical storage (assumed to be two cents per bushel per month in real terms throughout the period) plus the opportunity cost of storage. The monthly opportunity cost of storage per bushel was calculated as the monthly risk-free interest rate multiplied by the May futures price in November. Commission charges per round turn were assumed to be two cents per bushel in real terms for both futures and options contracts. All data were rounded to the nearest cent. All final results were adjusted for inflation using the Prices Paid by Farmers Index (1985=100).

In all preharvest strategies (except the selective and multiple selective hedges and options) action in the market was assumed to occur during the second week of the month. For example, routine hedges were placed during the second week of May and July. For multiple hedging strategies, data were reviewed for sell signals beginning in the second week of the month. Harvest was assumed to be the first week of November. Storage was assumed to terminate in the first week of April.

A typical recommendation is that producers hedge or forward contract no more than one-half to two-thirds of their expected production. This recommendation is made to prevent farmers from forward pricing more than they actually produce, forcing them to buy back futures contracts or the commodity at potentially high prices. To incorporate this recommendation into this analysis, all preharvest hedging was restricted to no more than 60 percent of expected production. Expected production was modeled by the prior three-year median of statewide yields. No such restriction was placed on put option purchases because the buyer of a put can not lose more than the premium if the price increases.

The Target MOTAD Model

Target MOTAD (see Watts, Held, and Helmers; and Tauer) was employed to determine risk-efficient portfolios of marketing strategies. Target MOTAD maximizes expected income subject to a given level of expected absolute negative deviation below a fixed target and other technical constraint. The identified portfolios are second degree stochastic dominant, as demonstrated in Tauer.

The target MOTAD model used in this analysis can be expressed as:

$$\begin{aligned} \text{maximize:} \quad & yx \\ \text{subject to:} \quad & Ax \geq \text{or} \leq b \\ & -Yx + Tx + Id^- \leq 0 \\ & vd^- \leq \delta \\ & x,\ d^- \geq 0, \text{ where:} \end{aligned}$$

y = a 1 by n vector of expected revenues from each strategy;

x = an n by 1 vector of the percent of the total portfolio represented by the various strategies;

A = an m by n matrix of technical coefficients, where m is the number of constraints and n is the number of strategies considered, including a row requiring total cash market sales to equal production from 100 acres;

b = an m by 1 vector of resource constraints;

Y = an s by n matrix of actual revenues for all strategies for the s years considered;

T = an s by n matrix in which all elements are the target represented by the fixed revenue per acre necessary to cover production costs;

I = an s by s identity matrix;

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

d^- = an s by 1 vector of deviations below the fixed revenue target;

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

δ = a scalar representing average deviations below the fixed revenue target;

Target MOTAD efficient frontiers were developed by parametrically varying negative deviations (δ) from levels associated with an initial LP solution in which risk was unconstrained. Risk-efficient frontiers were developed for optimum (maximum expected returns) solutions over a range of expected deviations from the included marketing activities. The mix of marketing strategies preferred by a producing firm depends on the nature of its revenue and risk preferences. It will select a portfolio at the tangency point between a iso-utility curve and the risk efficient frontier of optimal marketing plans. If the addition of new marketing activities causes a shift of the frontier toward greater returns for a given level of risk, the addition improved the risk-return scenario for the firm by enabling it to reach a higher level of utility.

The targets in Target MOTAD are the reference points from which deviations (risk) are measured. The choice of an appropriate target(s) is (are) crucial when applying this technique. Risk-efficient frontiers can be developed for various fixed targets to allow for interfirm differences in returns required for long-run survival. One method would be to allow the economic application to dictate the number and magnitude of targets examined. An appropriate target in producer marketing would be a level of return adequate to assure the long-run survival of the firm.

A target of $158 per acre was selected for measuring the risk associated with the marketing strategies examined in this study. The target reflects total costs per acre, excluding costs of risk and management, for dryland full season (not double-cropped with a small grain) soybeans specified in Clemson University enterprise budgets for 1985. The target was selected as a level of returns necessary to assure the long-run survival of the firm.

OPTIMAL SOYBEAN MARKETING PORTFOLIO IDENTIFICATION

The expected revenue per acre and risk, defined as the average negative deviation from the estimated South Carolina cost of $158 per acre, generated by the 24 marketing strategies in all time periods were calculated and ranked, Tables 2, 3, and 4.

A notable result is that option strategies performed well in all periods. They comprised at least five of the top 10 revenue producing alternatives in all periods. They also were among the five to eight least risky alternatives during the intervals reviewed. While options were very strong contributors in the 1970's, they also ranked high in the 1960's. This seems to contradict the idea that options would not be useful in flat price markets.

Storage strategies ranked high in all periods. Seven to eight of the top ten revenue producing strategies and six to eight of the lowest ten risky alternatives in all time periods involved storage until April.

Storage of all production would be consistent with the behavior of the real dollar historic nearby basis pattern in South Carolina which improved an average of $0.49 per bushel from November to April during the 1962-85 study period.

The cash and futures speculative strategies generally did not perform as well as the other strategies. One exception was unpriced storage until April which ranked near the top during the 1962-71 period. Cash sale at harvest and taking a long futures position until April involved substantially higher risk than the other strategies in all periods. Cash sale at harvest generally ranked low in revenue and in the middle in riskiness.

Routine and selective preharvest hedging performed poorly during all periods studied. This was attributed primarily to yield variability over the study period and subsequent futures losses. For example, in 1980 a routine hedge in May for harvest delivery would have lost $2.48 per bushel on 60 percent of expected production (22 bu.) when actual production averaged only 13 bushels.

Table 5 displays the preferred portfolios of soybean marketing strategies, with and without options available to the producers and the associated expected revenue and revenue shortfalls. Marketing strategy 3.10, routine purchase of a put option at harvest for April sale, strongly dominated all other strategies in the 1962-85 period (portfolio A). It was both the maximum revenue and minimum risk solution. This alternative was removed and the model re-optimized to check for secondary preferences. Preharvest and harvest purchases of puts entered the solution (portfolio B) at risk/return combinations inferior to those in the preferred portfolio (A). When options were excluded (portfolio C) the two dominant strategies were: 1) unpriced storage, which was replaced by 2) routine storage hedging at lower risk levels. It is clear that options contributed to revenue enhancement and risk abatement in this period. They increased expected revenue by $9.00 per acre while reducing risk by $3.00 per acre.

Portfolios D and E reflect the mix of alternatives favored during the 1962 to 1971 period. Again, Strategy 3.10 was by far the most robust alternative. When this strategy was excluded unpriced storage surfaced as preferred. As risk was restricted unpriced storage was replaced by a routine storage hedge placed at harvest for April sale. No preharvest marketing activity was included in the preferred mixes during this time period. While options increased expected revenue by only $0.25 per acre, risk was reduced. This was an important result as options were not expected to contribute much in flat-price periods.

When the model was run for the 1972-81 period portfolios F and G resulted, indicating that higher revenues and lower risk were associated with soybean production in the 1970's. Strategies with increased timing flexibility dominated during this period as expected. Maximum revenue was achieved with a selective put purchase strategy. As risk was restricted, routine put purchases entered the portfolio. In the absence of options, a multiple selective hedge during the storage period dominated the high revenue solution. With risk restricted, the multiple

selective hedge was replaced by a routine storage hedge. Options contributed considerably during this period, with a $15 increase in expected revenue and a $4 risk reduction (from high point to high point on frontiers).

Table 6 illustrates the performance of the individual strategies and the portfolios elicited during the 1982 through 1985 period, the time suggested as the beginning of a return to a "1960's market." Of the more notable results, seven of the top 10 (of 40) ranking marketing approaches were portfolios. In all cases, revenues were substantially lower (all below the cost target) and risk was greatly increased from the preceding decade. The portfolios with options achieved high ranks while the mixes without options ranked low. Also, the 1970's options-included portfolios generated higher revenue expectations and lower risks than those preferred in the 1960's. While not irrefutable evidence, this may suggest that the market of the 1980's is different from those of both earlier periods, yet one that is better modeled by the 1970's portfolios.

SUMMARY AND SOME LIMITATIONS

This analysis was conducted to determine the types of marketing strategies that would have been preferred during several time periods by a soybean producer whose objective was to maximize revenue per acre for a given chance that revenue would be less than the target. South Carolina price and yield data were used to determine preferred marketing strategies. Even though options were not traded during most of the period analyzed, the analysis examined strategies involving options to determine whether they would have been preferred if they had been available. Target MOTAD was used to select the portfolios on the efficient frontiers.

There are limitations to these results. While the elicited portfolios are second degree stochastic dominant, they are optimal only for the location and time periods analyzed. In addition, the potential exists for different results for individual farmers because their basis patterns and yields differ from state averages. The results also are optimal only for the marketing strategies included. Inclusion of additional strategies might produce portfolios that would dominate those discussed here. Finally, the results of strategies involving options are dependent on the simulated premiums. Although the Black model typically is used in explaining and predicting option premiums, actual premiums might have been different from the simulated premiums.

Some major conclusions can be drawn from the results. First, the portfolios on the efficient frontier for South Carolina differ across the time periods examined. Routine post harvest hedging and unpriced storage activities dominated the more flexible strategies in the 1960's. The reverse was true during the 1970's. A second major result was that storing until April provided consistent revenue enhancement and risk abatement across all periods due to strong basis improvement in most years. Cash sale at harvest and futures speculation were not preferred marketing activities in any period. Futures market speculation

increased risk substantially in all periods. Preharvest hedging was not preferred even when pricing was limited to 60 percent of expected yields. This was attributed to large inter-year yield variations that were associated with futures losses. A better measure of expected yields and an improved preharvest hedging restriction might have improved performance of these strategies.

The addition of strategies involving options resulted in an increase in expected revenues and a decrease in expected risk in all periods. It is especially important to note that an options strategy was preferred in the 1962-71 period. This runs counter to the idea that options are not useful in markets with relatively stable prices. The results support the conclusion that options provide an important means by which soybean producers can increase revenues and decrease price risk.

Finally, examining the performance of the individual strategies and the portfolios elicited during the period 1982 through 1985 showed that portfolios with options achieved good results. Also, the portfolios from the 1970's with options generated higher revenues and lower risks than those preferred in the 1960's. This suggests that the market of the 1980's is different from the markets of the two earlier periods.

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Table 1. Individual Marketing Strategies Considered for Possible Inclusion in Optimal Portfolios

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1. CASH MARKET SPECULATIVE STRATEGIES
   - 1.1 Unpriced Sale at Harvest (cash sale in November)
   - 1.2 Unpriced Storage (cash sale in April)

2. ROUTINE HEDGES
   - 2.3 Hedge in May for Nov. (place hedge in May using January contract; cash sale and lift hedge in November)
   - 2.4 Hedge in July for Nov. (place hedge in July using January contract; cash sale and lift hedge in November)
   - 2.5 Hedge in July for Apr. (place hedge in July using May contract; cash sale and lift hedge in April)
   - 2.6 Hedge in Nov. for Apr. (place hedge in November using May contract; cash sale and lift hedge in April)

3. ROUTINE PUT OPTION PURCHASES
   - 3.7 Buy Put in May for Nov. (buy a near-the-money put in May using the January contract; cash sale and sell put in November)
   - 3.8 Buy Put in July for Nov. (buy a near-the-money put in July using the January contract; cash sale and sell put in November)
   - 3.9 Buy Put in July for Apr. (buy a near-the-money put in July using the May contract; cash sale and sell put in April)
   - 3.10 Buy Put in Nov. for Apr. (buy a near-the-money put in November using the May contract; cash sale and sell put in April)

4. SELECTIVE HEDGES SIGNALED BY DUAL MOVING AVERAGES
   - 4.11 3+5 Hedge in May for Nov. (in May start looking for a sell signal based on three and five week moving averages and place hedge in January contract when first sell signal is noted; cash sale and lift hedge in November)
   - 4.12 3+5 Hedge in July for Nov. (in July start looking for a sell signal based on three and five week moving averages and place hedge in January contract when first sell signal is noted; cash sale and lift hedge in November)
   - 4.13 3+5 Hedge in July for Apr. (in July start looking for a sell signal based on three and five week moving averages and place hedge in May contract when first sell signal is noted; cash sale and lift hedge in April)
   - 4.14 3+5 Hedge in Nov. for Apr. (in November start looking for a sell signal based on three and five week moving averages and place hedge in May contract when first sell signal is noted; cash sale and lift hedge in April)

(Cont.)

Table 1. Individual Marketing Strategies Considered for Possible Inclusion in Optimal Portfolios (Cont.)

5. SELECTIVE PUT OPTION PURCHASES SIGNALED BY DUAL MOVING AVERAGES
   - 5.15 3+5 Buy Put in May for Nov. (in May start looking for a sell signal based on three and five week moving averages and buy near-the-money put in January contract when first sell signal is noted; cash sale and sell put in November)
   - 5.16 3+5 Buy Put in July for Nov. (in July start looking for a sell signal based on three and five week moving averages and buy near-the-money put in January contract when first sell signal is noted; cash sale and sell put in November)
   - 5.17 3+5 Buy Put in July for Apr. (in July start looking for a sell signal based on three and five week moving averages and buy near-the-money put in May contract when first sell signal is noted; cash sale and sell put in April)
   - 5.18 3+5 Buy Put in Nov. for Apr. (in November start looking for a sell signal based on three and five week moving averages and buy near-the-money put in May contract when first sell signal is noted; cash sale and sell put in April)

6. MULTIPLE SELECTIVE HEDGES SIGNALED BY DUAL MOVING AVERAGES
   - 6.19 3+5 Multiple Hedge in May for Nov. (in May start looking for sell signals based on three and five week moving averages and place hedge in January contract when sell signal is noted; lift hedge when buy signal is noted; continue placing and lifting hedges until November when cash sale is made and any remaining hedge is lifted)
   - 6.20 3+5 Multiple Hedge in July for Nov. (in July start looking for sell signals based on three and five week moving averages and place hedge in January contract when sell signal is noted; lift hedge when buy signal is noted; continue placing and lifting hedges until November when cash sale and any remaining hedge is lifted)
   - 6.21 3+5 Multiple Hedge in July for Apr. (in July start looking for sell signals based on three and five week moving averages and place hedge in May contract when sell signal is noted; lift hedge when buy signal is noted; continue placing and lifting hedges until April when cash sale and any remaining hedge is lifted)
   - 6.22 3+5 Multiple Hedge in Nov. for Apr. (in November start looking for sell signals based on three and five week moving averages and place hedge in May contract when sell signal is noted; lift hedge when buy signal is noted; continue placing and lifting hedges until April when cash sale and any remaining hedge is lifted)

7. OPTIONS/FUTURES MARKET SPECULATIVE STRATEGIES
   - 7.23 Buy Call in Nov. for Apr. (in November sell in cash market and buy a near-the-money call on the May contract; sell call in April)
   - 7.24 Buy Futures in Nov. for Apr. (in November sell in cash market and buy May futures contracts; sell futures in April)

Table 2. Ranking of South Carolina Soybean Marketing Strategies, by Revenue and Risk, 1962 through 1985.

Strategy	Expected Revenue	Expected Risk[a]	Revenue[b]	Risk[c]
	($/ac)	($/ac)	rank	rank
1.1	157.04	14.32	18	10
1.2	164.97	14.64	6	13
2.3	149.12	17.63	24	23
2.4	154.27	16.65	20	20
2.5	161.12	13.79	10	9
2.6	161.36	12.14	8	2
3.7	159.49	12.54	15	4
3.8	160.99	13.62	11	7
3.9	171.27	12.51	3	3
3.10	173.21	11.47	1	1
4.11	152.01	16.59	23	19
4.12	153.82	16.50	22	18
4.13	160.25	13.74	12	8
4.14	157.76	15.06	17	14
5.15	159.76	13.39	14	6
5.16	158.49	15.45	16	16
5.17	172.34	12.63	2	5
5.18	165.04	14.60	5	12
6.19	155.16	15.34	19	15
6.20	154.20	16.12	21	17
6.21	160.14	16.85	13	21
6.22	161.20	16.93	9	22
7.23	166.76	14.46	4	11
7.24	162.36	26.80	7	24

[a]Expected risk of falling below $158/acre gross income.
[b]Highest expected revenues = 1.
[c]Lowest expected risk = 1.

Table 3. Ranking of South Carolina Soybean Marketing Strategies, by Revenue and Risk, 1962 through 1971.

Strategy	Expected Revenue	Expected Risk[a]	Revenue[b]	Risk[c]
	($/ac)	($/ac)	rank	rank
1.1	155.86	9.62	11	6
1.2	161.24	9.42	2	4
2.3	148.35	14.19	24	23
2.4	152.21	12.30	15	15
2.5	157.14	10.65	9	9
2.6	156.06	9.41	10	3
3.7	151.80	12.13	16	13
3.8	153.89	11.71	13	12
3.9	161.16	10.57	4	8
3.10	161.56	8.53	1	1
4.11	148.51	14.08	23	22
4.12	151.27	12.75	20	18
4.13	155.45	10.92	12	10
4.14	157.19	9.51	8	5
5.15	151.57	12.48	19	16
5.16	152.45	12.91	14	19
5.17	159.15	11.00	5	11
5.18	161.20	9.34	3	2
6.19	150.10	13.28	22	20
6.20	151.73	12.54	17	17
6.21	150.61	13.51	21	21
6.22	151.65	12.23	18	14
7.23	157.73	10.53	7	7
7.24	158.84	14.50	6	24

[a]Expected risk of falling below $158/acre gross income.
[b]Highest expected revenues = 1.
[c]Lowest expected risk = 1.

Table 4. Ranking of South Carolina Soybean Marketing Strategies, by Revenue and Risk, 1972 through 1981.

Strategy	Expected Revenue	Expected Risk[a]	Revenue[b]	Risk[c]
	($/ac)	($/ac)	rank	rank
1.1	174.72	7.88	18	11
1.2	187.98	9.22	8	13
2.3	162.38	12.08	24	23
2.4	172.55	9.95	20	19
2.5	181.96	6.84	12	7
2.6	182.39	5.34	11	1
3.7	179.95	5.80	16	3
3.8	184.44	5.84	10	4
3.9	200.28	5.87	3	5
3.10	204.21	5.69	2	2
4.11	167.10	11.76	23	22
4.12	171.43	10.10	22	20
4.13	180.92	7.09	15	9
4.14	175.35	9.50	17	16
5.15	181.35	6.96	14	8
5.16	181.61	7.27	13	10
5.17	204.47	6.12	1	6
5.18	188.16	9.24	6	14
6.19	172.90	9.70	19	17
6.20	171.56	9.76	21	18
6.21	188.08	9.38	7	15
6.22	189.77	10.67	5	21
7.23	195.48	8.01	4	12
7.24	187.50	29.95	9	24

[a]Expected risk of falling below $158/acre gross income.
[b]Highest expected revenues = 1.
[c]Lowest expected risk = 1.

Table 5. Risk-Efficient Soybean Marketing Portfolios, With and Without Options, South Carolina, 1962 Through 1985.

Portfolio	Expected Revenue	Expected Risk	Selected Strategies						
			1.2	2.6	3.7	3.9	3.10	5.17	6.22
number	($/ac)	($/ac)	(%)	(%)	(%)	(%)	(%)	(%)	(%)
					1962-85 With Options				
A	173.21	11.57					100		
B.1	172.34	12.73						100	
B.2	167.18	12.25			5	30	65		
					1962-85 Without Options				
C.1	164.97	14.76	100						
C.2	163.35	13.75	63	37					
C.3	161.38	12.25		100					
					1962-71 With Options				
D	161.56	8.65					100		
					1962-71 Without Options				
E.1	161.24	9.49	100						
E.2	159.07	9.27	58	42					
E.3	156.90	9.14	16	84					
					1972-81 Without Options				
A.1	189.77	10.75							100
A.2	186.08	7.73		50					50
A.3	182.39	5.38		100					
					1972-81 With Options				
B.1	204.47	6.17						100	
B.2	192.89	5.28			37	61	2		
B.3	181.30	5.08			93	7			

Table 6. Ranking of Soybean Marketing Activities, South Carolina, 1982 through 1985.

Strategy or Portfolio	Revenue	Risk	Strategy Revenue	Risk	Portfolio Revenue	Risk
number	($/ac)	($/ac)	rank	rank	rank	rank
1.1	115.83	42.17	18	18	33	33
1.2	116.77	41.23	16	16	31	31
2.3	117.91	40.09	12	12	24	24
2.4	113.72	44.28	22	22	37	37
2.5	118.99	39.01	11	11	21	21
2.6	122.02	35.98	8	8	17	17
3.7	127.57	30.43	1	1	1	1
3.8	120.13	37.87	10	10	20	20
3.9	124.03	33.97	5	5	12	12
3.10	124.82	33.18	4	4	11	11
4.11	123.05	34.95	7	7	14	14
4.12	116.16	41.84	17	17	32	32
4.13	120.57	37.43	9	9	19	19
4.14	115.20	42.80	20	20	35	35
5.15	126.27	31.73	2	2	3	3
5.16	115.77	42.23	19	19	34	34
5.17	125.01	32.99	3	3	5	5
5.18	116.83	41.17	15	15	28	28
6.19	123.43	34.57	6	6	13	13
5.20	117.01	40.99	14	14	27	27
6.21	114.13	43.87	21	21	36	36
6.22	113.65	44.35	23	23	39	39
7.23	117.56	40.44	13	13	26	26
7.24	108.31	49.69	24	24	40	40
A1	113.65	44.35			38	38
A2	117.83	40.17			25	25
A3	122.02	35.98			16	16
B1	125.01	32.99			6	6
B2	125.36	32.64			4	4
B3	127.32	30.68			2	2
A	124.82	33.18			10	10
B1	125.01	32.99			7	7
B2	124.99	33.01			8	8
C1	116.77	41.23			29	29
C2	118.71	39.29			23	23
C3	122.02	35.98			15	15
D	124.82	33.18			9	9
E1	116.77	41.23			30	30
E2	118.97	39.03			22	22
E3	121.18	36.82			18	18