RETURNS AND RISK FROM ALTERNATIVE PRE-HARVEST SOYBEAN PRICING STRATEGIES USING CASH, FUTURES, AND OPTIONS MARKETS

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ABSTRACT

Returns and Risk from Alternative Pre-Harvest Soybean Pricing Strategies Using Cash, Futures, and Options Markets

With the lifting of the ban on commodity options, in 1983, new alternatives for marketing soybeans became available. Because options are new there has been limited research on the impact they have on farmers' returns and risk. The objectives of this study were to: 1) test how option strategies perform compared to futures and cash strategies, 2) evaluate strategies that sell options as well as multiple option positions, and 3) compare adjustment strategies to set and hold strategies. The evaluation criteria were returns measured as the weighted average revenue per bushel, and risk measured as the average negative deviation below total cost of production.

This study modeled a Northern Indiana farmer marketing 500 acres of soybeans per year from 1975 to 1988. A computer simulation was developed to evaluate 48 different marketing strategies. The marketing strategies fell in four general classes: 1) Control Strategies, 2) Timing Strategies, 3) Cost of Production Strategies, and 4) Technical Analysis Strategies.

Results indicate that options generated 9 of the top 10 revenue producing strategies and 5 of the 10 lowest risk producing strategies. Non-speculative put and call combination strategies achieved near optimum results, while the adjustment strategies examined were unable to substantially improve returns by capturing pre-harvest price moves.

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The Problem

Pricing performance is a critical factor in a farm's financial success. The decision of which pricing tools to use and when to apply them, largely determines the level of performance. Before 1984 the two main pricing tools available to farmers were the cash forward contract and the futures contract. However, with the lifting of the ban on commodity options in 1983, a new and powerful marketing tool became available.

Because options are relatively new, there has been limited research on how they affect the level of returns and the interyear variability of these returns. The results of studies to date are mixed. Butler concluded that options would be preferred to futures and cash, in marketing corn from 1972 to 1984, if option premiums were not excessively high, using 5%, 10% and 15% of the price of corn for the premium levels. Curtis, Kahl, and McKinnell found that among various marketing strategies for soybeans, options performed well in all periods, from 1962 to 1985. Options comprised at least five of the top ten revenue producing strategies and were among five to eight of the least risky alternatives over that period. However, in Schroeder and Hayenga's study, the purchase of routine put options on live cattle produced the lowest mean return of all the tested strategies and the variance was not significantly lower than the cash market.

These studies only evaluated simple option strategies, such as the purchase of put options. They neglected the selling of options and multiple option positions. In addition, none of the studies have considered the opportunity of offsetting an option

early. Holding an option till harvest eliminates the opportunity to capture any mid-summer price moves. For example, in 1988 the futures price at the beginning of May was $7.14. It increased to $10.22 by the end of June, but then fell back to around $8.00 at harvest. Purchasing a put option in May and holding it till harvest would have missed the top of the price move by $2.00, thus missing the full opportunity an option provides. It appears that it would be advantageous to use some form of adjustment strategy to reach these higher prices.

Objectives

The three main objectives of this study, using returns and risk as criteria were to:

1. Test how options strategies, in general, perform against futures and cash marketing strategies.
2. Evaluate additional option strategies, that include selling options and combining options.
3. Compare adjustment strategies, which attempt to capture major price moves, with set and hold strategies.

Methodology

This study modeled a Northern Indiana soybean farm capable of producing at least 500 acres of soybeans per year. A computer simulation model was developed to evaluate various marketing strategies over the fourteen crop years from 1975 to 1988. Daily November soybean futures prices were utilized in the analysis and basis levels were obtained from a nearby export subterminal. Basis was assumed to be at the average October level for each year. Since forward basis was not available, the same annual basis level was used for pre-harvest, as well as, harvest pricing strategies. Actual option premiums were unavailable for most of the data period, thus the Black model was used to estimate

theoretical option premiums. The market volatility used in the Black model was based on the last 20 price observations.

Transaction costs, consisting of commissions and interest on margin and option premiums, were subtracted from the revenues generated by each strategy. Commissions were set at $100 per round turn. This was set high to cover any execution error that might result. Execution error is the difference between the quoted historical price and the price at which a buy or sell order could have actually been filled (Irwin and Uhrig). The margin requirements were set high at $2500 to achieve an estimate of the opportunity interest cost, on the margin, without marking-to-the-market each day. Annualized short term T-bill rates were used as the appropriate interest cost.

Curtis, Kahl and McKinnell suggest that producers not hedge more than one-half to two-thirds of expected production to prevent forward pricing more than produced. Following this line of reasoning, in this study only 60 percent of expected production was priced for strategies using cash contracts, futures contracts and the selling of options. For purchasing of options, 100 percent of expected production was hedged, since the buyer cannot lose more than the premium. The number of bushels traded, when futures and options markets were used, was rounded down to the nearest whole 5,000 bushel contract size. Expected production was estimated by averaging county yields from three prior years.

Selection methods used for adjusting a futures or options position were generated by two criteria; cost of production and the Donchian technical analysis system. The cost of production

figures were obtained from the 1975 to 1988 Purdue Crop Guides. Adjustments to initial positions were made when prices moved by a predetermined amount from the cost of production. The Donchian system was selected because it was found to be the most profitable technical analysis system for soybeans in a study completed by Irwin and Uhrig. The Donchian system is a weekly pricing channel. It generates a buy signal when futures rises above the highest price in a specified time interval and a sell signal when the futures falls below the lowest price in the same interval (Irwin and Uhrig). Wade performed an optimization test over 1960-74 for the Donchian system. His results indicated a 12 week optimal interval, which was used for this study.

There were four general classes of pricing strategies. The four were: 1) Control Strategies, 2) Timing Strategies, 3) Cost of Production Strategies, and 4) Technical Analysis Strategies. A complete description of all 48 strategies is in Appendix A. The results of the control strategies provide a scale for comparison. These strategies included pricing at harvest; pricing equal amounts each month; an upper and lower bound established by the highest and lowest prices, ex-post; and a composite strategy which selected a different strategy randomly each of the 14 years. The timing strategies consisted of eight different strategies that were each placed on the 15 of May, June, and July. The cost of production strategies consisted of two set and hold strategies placed at four different margin levels, and three adjustment strategies rolled at two different increment levels. Included in the technical analysis class were five strategies which used the Donchian system to signal when to

place and lift futures and option positions.

To evaluate these strategies a returns and risk comparison was used. Returns were the average price per bushel received, weighted by yearly production. The average negative deviation below the cost of production was used as the measure of risk, similar to Curtis, Kahl, and McKinnell. This produced a measure of the risk of loss that farmers actually face, rather than a variance measure which does not. Variance measures of risk consider both the up and down side of variability. The average negative deviations measure only considers the downside risk below costs. When this measure is used in combination with mean returns it provides a more realistic means of evaluating pricing performance.

Results

The results of the control group strategies over the period 1975 to 1988 are presented in Table 1. The last two columns present the over all ranking of the 48 strategies, with 1 equaling the highest revenue producing strategy and the lowest risk producing strategy. Marketing cash grain at harvest every year produced a return of $6.04 per bushel and a risk of 6.60 percent. This can be interpreted that in an average year the negative deviations average 6.60 percent of the revenue per acre. Selling equal monthly increments of cash grain throughout the growing season increased returns by $0.14 and reduced risk nearly half. Even the random marketing strategy generated a higher return and lower risk than selling in the fall. The upper bound at $6.54 and the lower bound at $5.73 give an idea of the optimal or minimal prices, given perfect price knowledge. Thus any

Table 1 CONTROL GROUP STRATEGIES' RESULTS

STRATEGY	DESCRIP	WT AVE REV/BU	(1) RISK	(2) REV/BU	(3) RISK
		$	%	RANK	RANK
1.111	Cash Fall	6.04	6.60	42	44
1.121	Cash Mthly	6.18	3.41	12	6
1.131	Upper Bound	6.56	2.23	1	1
1.141	Lower Bound	5.73	7.62	46	45
1.151	Random	6.13	5.36	25	33

1. Percent average negative deviation below the cost of production per acre.
2. Highest revenue per bushel is = 1
3. Lowest risk is = 1

strategy near these levels are near optimum or minimum.

The results for the timing strategies are presented in Table 2. The simple purchase of put options in May generated higher returns and lower risk than selling futures or selling calls. The same results were true for pricing in June, except that each strategies' returns and risks increased. However, by mid July the strategies which sold futures and calls generated higher prices. It appears that premium values increased through mid-summer, as a result of increased price volatility through June and the first half of July, due to the uncertainty of production during the growing season. Thus, the put premiums were favorably priced in the early summer, but overly priced by mid July. Still, purchasing puts in July produced better results than selling cash at harvest.

The synthetic put produced mediocre returns and risk. This strategy performed better in May and June, like the put, but not as well as the put. This could be explained by the additional

Table 2 TIMING STRATEGIES' RESULTS

STRATEGY	DESCRIP	WT AVE REV/BU	(1) RISK	(2) REV/BU	(3) RISK
		$	%	RANK	RANK
	MAY 15				
2.211	Sell Fut	6.09	3.71	31	8
2.321	Buy Put	6.22	3.06	8	3
2.431	Sell Call	5.99	5.40	44	34
2.541	Synth Put	6.13	4.78	24	23
2.551	Short Strad	5.71	9.80	47	46
2.561	Long Strad	6.29	5.56	6	35
2.571	Bear Spread	6.19	4.13	11	12
2.581	Bull Spread	6.04	4.34	40	16
	JUNE 15				
2.212	Sell Fut	6.18	3.70	13	7
2.322	Buy Put	6.29	3.14	5	4
2.432	Sell Call	6.03	5.20	43	31
2.542	Synth Put	6.17	4.77	17	22
2.552	Short Strad	5.69	10.33	48	48
2.562	Long Strad	6.32	5.96	4	42
2.572	Bear Spread	6.41	3.18	3	5
2.582	Bull Spread	6.09	4.56	32	17
	JULY 15				
2.213	Sell Fut	6.17	4.17	16	13
2.323	Buy Put	6.06	5.09	35	27
2.433	Sell Call	6.15	4.79	23	24
2.543	Synth Put	6.05	5.83	39	40
2.553	Short Strad	6.18	5.59	14	37
2.563	Long Strad	5.84	10.09	45	47
2.573	Bear Spread	6.44	2.69	2	2
2.583	Bull Spread	6.12	4.73	26	20

1. Percent average negative deviation below the cost of production per acre.
2. Highest revenue per bushel is = 1
3. Lowest risk is = 1

transaction cost required to implement it.

The short and long straddle produced opposite results. The short straddle performed as a magnified call sell. As the call, it performed better in July than in May or June, but with far greater swings in risk and returns. The long straddle performed

as a magnified put purchase, generating greater returns in May and June than in July. The long straddle produced some of the highest returns in May and June, but had some of the highest risk.

The bear spread produced the highest return, other than the upper boundary, and one of the lowest risk. It's returns rose through out May, June, and July, while it's risk fell. The bull spread also had increases in returns through May, June, and July, but did not perform as well as the bear spread. These results suggest there was seasonality in futures prices over this period. Futures prices, on average, rose through May, June, and July, and then fell into harvest. Thus, the bear spread performed better than the bull spread.

The results for the cost of production strategies are presented in Table 3. Set and hold strategies were set at $0.25, $0.50, $0.75, and $1.00 margins above the cost of production, while adjustment strategies were set at cost of production and rolled when the market moved up by $0.50 or $1.00. Within these strategies, the adjustment strategies performed better than the set and hold strategies. However, they did not perform as well as the timing strategies. This lower performance is most likely related to the years in which the futures never reached the cost of production. For the set and hold strategies, the lower margin levels performed better, because they generated a sell signal in more of the years. The buying of puts out performed the selling of futures at every margin level for both returns and risk.

The put roll up, and the put roll up and hold strategies performed the best under the $0.50 increment. This would suggest

Table 3 COST OF PRODUCTION STRATEGIES' RESULTS

STRATEGY	DESCRIP	WT AVE REV/BU	(1) RISK	(2) REV/BU	(3) RISK
		$	%	RANK	RANK
	Set & Hold (+ 0.25)				
3.211	Sell Fut	6.06	5.33	37	32
3.321	Buy Put	6.16	4.70	18	19
	(+ 0.50)				
3.212	Sell Fut	6.10	5.17	29	29
3.322	Buy Put	6.16	4.85	20	26
	(+ 0.75)				
3.213	Sell Fut	6.04	5.96	41	43
3.323	Buy Put	6.08	5.75	33	39
	(+ 1.00)				
3.214	Sell Fut	6.08	5.92	34	41
3.324	Buy Put	6.10	5.74	30	38
	Adjustment (+ 0.50)				
3.331	Put Roll Up	6.15	4.30	21	15
3.341	Put Roll & Hold	6.22	5.19	9	30
3.551	Put-Fut	6.06	5.10	36	28
	(+ 1.00)				
3.332	Put Roll Up	6.11	4.82	28	25
3.342	Put Roll & Hold	6.06	5.56	38	36
3.552	Put-Fut	6.15	4.69	22	18

1. Percent average negative deviation below the cost of production per acre.
2. Highest revenue per bushel is = 1
3. Lowest risk is = 1

that gains exceeded the transaction cost for each roll, because there would have been more roll ups with the $0.50 increment than with the $1.00 increment. The put roll up to futures performed the best with the $1.00 increment. This strategy rolled up only once, so under the $1.00 increment it was able to achieve a larger gain before the minimum price was switched to a fixed price.

The results for the technical analysis strategies are

Table 4 TECHNICAL ANALYSIS STRATEGIES' RESULTS

STRATEGY	DESCRIP	WT AVE REV/BU	(1) RISK	(2) REV/BU	(3) RISK
		$	%	RANK	RANK
	Set & Hold				
4.111	Cash Donch	6.11	3.88	27	9
	Adjustment				
4.221	Fut Long+Short	6.27	4.30	7	14
4.322	Put Long+Short	6.16	4.76	19	21
4.231	Fut Short	6.17	4.11	15	11
4.332	Put Long	6.19	3.99	10	10

1. Percent average negative deviation below the cost of production per acre.
2. Highest revenue per bushel is = 1
3. Lowest risk is = 1

presented in Table 4. Over all, these strategies performed better than the cost of production strategies, but not as well as the timing strategies. The cash strategy performed better than selling cash at harvest. However, it didn't perform as well as the equal monthly pricing strategy. Out of the other four strategies the long and short adjustable futures generated the highest return, but required next to the highest risk. The long only adjustable put strategy had higher returns and lower risk than the short only futures strategy.

A possible reason why these strategies did not perform as well as the timing strategies was the wide pricing channel. For example, the 12 week channel missed the whole price move in 1988. If the Donchian system was reoptimized every three years, for example, these strategies may have exhibited improved performance.

Summary and Conclusions

Options performed well in every class of strategies examined. Purchasing put options provided a simple means of increasing revenue per bushel and lowering risk in comparison to the basic cash strategies and selling futures early in the production season. Options strategies represented nine of the top ten revenue producing strategies, (not including the upper bound), and five of the top ten risk averting strategies.

Non-speculative put and call combination strategies, such as the bear spread, provided opportunities to greatly increase returns, while also reducing risk. However, the more speculative combination strategies, such as the short straddle, produced some of the lowest returns and highest risk.

Adjustment strategies, that attempted to hit the high for the production season, did not perform substantially better than the set and hold strategies. This indicates that the systems providing the pricing signals were not able to capture the price moves. For example, the cost of production selection method did not give a signal in three out of the fourteen years and the 12 week parameter for the Donchian system missed the whole price move in 1988. In addition, increased transaction cost, as a result of being in and out of the market, eliminated the majority of the gains made by the adjustments.

This study supports the hypothesis that simple option strategies can enhance price performance. In addition, it lends strong evidence that options can reduce negative price risk, while leaving the positive price moves in place. This has major implications for producers who need lower risk pricing

alternatives. In addition, these options strategies have important liquidity implications as simple option positions require lower levels of financial backing since no margin calls are made.

Perhaps a greater contribution is provided by the examination of more complex strategies which have previously not been tested. The favorable performance of the non-speculative put and call combinations suggest that using options to establish a window of price opportunity should be strongly considered by producers. Finally, while we all like to think we can out guess the market, the adjustment strategies attempting to do this were unable to improve pricing performance.

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APPENDIX A

Marketing Strategies

1. CONTROL STRATEGIES
   - 1.111 Cash Sale at Harvest: Oct. 15
   - 1.121 Cash Contract, Equal Monthly Sales:
     Forward contract equal portions of expected production (EP) on the 15 of each month, starting in May and ending in October.
   - 1.131 Upper Boundary:
     Cash grain was sold, at 60% of EP, on the high of each year, based on the May 15, June 15, July 15, and October 15 prices.
   - 1.141 Lower Boundary:
     Cash grain was sold, at 60% of EP, on the low of each year, based on the May 15, June 15, July 15, and October 15 prices.
   - 1.151 Random Strategy:
     One of the fifty strategies was pulled out of a hat for each individual year simulated.

2. TIMING STRATEGIES
   - 2.211 Sell Futures in May:
     Sell November soybean futures, at 60% of EP, on May 15, and offset them and sell cash on October 15.
   - 2.212 Sell Futures in June:
     Same as 2.211, except with June hedge placement.
   - 2.213 Sell Futures in July:
     Same as 2.211, except with July hedge placement.
   - 2.321 Buy a Put in May:
     Buy November at-the-money put options, at 100% of EP, on May 15 and offset them on October 15 or let them expire, and sell cash.
   - 2.322 Buy a Put in June:
     Same as 2.321, except with a June 15 purchase.
   - 2.323 Buy a Put in July:
     Same as 2.321, except with a July 15 purchase.
   - 2.431 Sell a Call in May:
     Sell November at-the-money call options, at 60% of EP, on May 15 and offset them on October 15, and sell cash.
   - 2.432 Sell a Call in June:
     Same as 2.431, except with a June 15 sell.
   - 2.433 Sell a Call in July:
     Same as 2.431, except with a July 15 sell.
   - 2.541 Synthetic Put in May:
     Sell November futures and buy at-the-money calls, at 60% of EP, on May 15. On October 15, offset the futures and the calls and sell cash.
   - 2.542 Synthetic Put in June:
     Same as 2.541, except with June placement.
   - 2.543 Synthetic Put in July:
     Same as 2.541, except with July placement.
   - 2.551 Short Straddle in May:

Sell November at-the-money put and call options, at 100% of EP, on May 15. Offset both positions and sell cash on October 15.

2.552 Short Straddle in June:
Same as 2.551, except with June placement.

2.553 Short Straddle in July:
Same as 2.551, except with July placement.

2.561 Long Straddle in May:
Purchase November at-the-money put and call options, at 100% of EP, on May 15. Offset both positions and sell cash on October 15.

2.562 Long Straddle in June:
Same as 2.561, except with June placement.

2.563 Long Straddle in July:
Same as 2.561, except with July placement.

2.571 Bear Spread in May:
Buy November $0.50 in-the-money puts and sell November $0.50 in-the-money calls, at 100% of EP, on May 15. Offset both positions and sell cash on October 15.

2.572 Bear Spread in June:
Same as 2.571, except with June placement.

2.573 Bear Spread in July:
Same as 2.571, except with July placement.

2.581 Bull Spread in May:
Buy November $0.50 out-of-the-money puts and sell November $0.50 out-of-the-money calls, at 100% of EP, on May 15. Offset both positions and sell cash on October 15.

2.582 Bull Spread in June:
Same as 2.581, except with June placement.

2.583 Bull Spread in July:
Same as 2.581, except with July placement.

3. COST OF PRODUCTION STRATEGIES

3.211 Sell Futures in May, Cost of Production:
Start looking for a sell signal in May based on the cost of production. Sell November futures, at 60% of EP, when it reaches the level of the cost of production (COP) plus basis plus $0.25, and offset the position and sell cash on October 15.

3.212 Sell Futures in May, Cost of Production:
Same as 3.211, except with a $0.50 margin.

3.213 Sell Futures in May, Cost of Production:
Same as 3.211, except with a $0.75 margin.

3.214 Sell Futures in May, Cost of Production:
Same as 3.211, except with a $1.00 margin.

3.321 Buy a Put in May, Cost of Production:
Start looking for a sell signal in May based on the COP. Buy November at-the-money put options, at 100% of EP, when the futures reaches the level of the COP plus basis plus $0.25, and offset them or let them expire on October 15, and sell cash.

3.322 Buy a Put in May, Cost of Production:
Same as 3.321, except with a $0.50 margin.

3.323 Buy a Put in May, Cost of Production:

Same as 3.321, except with a $0.75 margin.

3.324 Buy a Put in May, Cost of Production:
Same as 3.321, except with a $1.00 margin.

3.331 Put Roll Up, COP:
Start looking for a sell signal in May based on the COP. Buy November at-the-money put options, at 100% of EP, when the futures reaches the level of the COP plus basis. Roll up puts at every $0.50 increment by selling the original puts and purchasing new puts at the higher strike price. Offset the final puts and sell cash on October 15.

3.332 Put Roll Up, COP:
Same as 3.331, except with $1.00 increments.

3.341 Put Roll Up & Hold, COP:
Same as 3.331, except each put purchased was held until October 15.

3.342 Put Roll Up & Hold, COP:
Same as 3.332, except each put purchased was held until October 15.

3.551 Put Roll Up to Futures, COP:
Start looking for a sell signal in May based on the COP. Buy November at-the-money put options, at 100% of EP, when the futures reaches the level of the COP plus basis. Roll up and change the minimum price to a fixed price by selling the puts and selling futures, at 60% of EP, at the first $0.50 increment. Offset the futures and sell cash on October 15.

3.552 Put Roll Up to Futures, COP:
Same as 3.551, except with a $1.00 increment.

4. TECHNICAL ANALYSIS STRATEGIES

4.111 Cash Contract, Donchian System:
Forward contract 60% of EP on the first sell signal generated by the Donchian system.

4.221 Adjustable Futures, Long & Short, Donchian System:
Start looking for a signal in May based on the Donchian System. Sell November futures, at 60% of EP, when a sell signal is received and buy futures when a buy signal is received. Each time a new signal is received a two for one trade is made to switch the position. Offset any positions held on October 15 and sell cash.

4.322 Adjustable Puts, Long & Short, Donchian System:
Start looking for a signal in May based on the Donchian System. Buy November at-the-money put options, at 100% of EP, when a sell signal is received and sell November at-the-money put options when a buy signal is received. Each time a new signal is received a two for one trade is made to switch the position. Offset any positions held on October 15 and sell cash.

4.231 Adjustable Futures, Short Only, Donchian System:
Same as 4.321, only short positions are held.

4.332 Adjustable Put, Long Only, Donchian System:
Same as 4.322, only long put positions are held.