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ABSTRACTS

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PRICE RISK MANAGEMENT ALTERNATIVES FOR COTTON: CASH MARKET, FUTURES CONTRACTS, AND OPTIONS

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ABSTRACT

Price variability has threatened the economic survival of High Plains producers and has forced them to consider marketing alternatives such as futures and options contracts for price risk management. Although futures hedging reduces price risk, options hedging goes one step further by allowing producers to profit in high price outcomes. Research indicates that under certain specified conditions options and futures hedging minimizes price risk for cotton operations on the Southern High Plains of Texas.

Key Words: Price risk management with options, Futures contracts

INTRODUCTION

Volatile commodity prices severely affect producers with high debt-to-asset ratios. Evidence of price risk indicated by the Commodity Price Index registered -7.9% for March 1978 and peaked at +31.3% for June 1979 (Pring). Consequently, producers concern themselves with adopting a marketing strategy which will minimize price risk and stabilize both income and cash flow.

Hedging with short futures and put options offer viable alternatives for price risk management. In an investigation of the Winnipeg rapeseed, barley, and flaxseed futures contracts, Carter concludes that futures are useful for reducing producers' exposure to price risk. It should be noted that while hedging routinely reduces price risk (Peck), this strategy frequently results in foregone opportunities in the event of rising price patterns (Brandt). For high price outcomes, completely hedged and optimally hedged positions generate lower incomes than option hedged positions (Gardner). Hence, producers who are risk averse in the face of large losses but risk loving in the event of large profits will prefer to hedge with options (Gardner). For example, during the years of 1979, 1981, and 1983, when futures prices for cotton initially remained stable, subsequently increased, and finally dropped, options would have registered the highest average returns over the three price changes, although, an options strategy would not have placed first in any given year (Anderson).

The Southern High Plains is a major cotton producing area and major regional market. Survival

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in today's economic environment requires that High Plains producers use strategies which insure against or minimize risk caused by price volatility. The general objective of this analysis involved comparing and evaluating the risk distribution capacity of three major marketing strategies for cotton--hedging with put options, hedging with short futures, and selling in the cash market. The study unit was assumed to be 640 acres of irrigated cotton in the Southern High Plains of Texas. The decision maker was assumed to desire optimal returns with minimal risk. More specifically the objectives included: evaluating a producer's risk for a rising and/or falling market while using any of the three strategies; evaluating a producer's risk for a narrowing and/or widening basis while using either of the two alternative hedging strategies; and determining which strategy would have been more profitable based on conditions as they exist in 1985.

ANALYTICAL FRAMEWORK

One criterion for strategy evaluation involves that of a risk versus return tradeoff. The concept of "Satisfycing" served as the basis for the tradeoff demonstrating that a rational manager will desire the best of both worlds--adequate returns with minimal risk. A producer can avoid all risk by not producing, the penalty being no returns. At the other extreme is the strategy of selling in the cash market with the associated potential of maximizing returns or losses. Somewhere in between are the strategies of hedging with short futures and put options. The strategy chosen will depend on the producer's utility function (Gardner). Presumably, a producer would prefer options in the probable event of losses and the likely event of profits. Even those producers who are uniformly averse to risk find options a promising strategy after moving from the idealized circumstances of advance price determination (Gardner).

The producer selects an option purchase strategy by considering the hedge ratio (delta). "Mathematically, delta is the slope of the option price curve and ranges in value from 0 to 1" (Dalton). Conceptually, delta is a sensitivity measurement of the unit response of option premiums to four variables. These variables include (1) volatility of the underlying futures contract, (2) time remaining before expiration, (3) interest rates, and (4) the striking price/market price relationship. In this analysis, only variable one will be allowed to fluctuate.

For a put option, delta is negative in value indicating an inverse relationship between futures prices and option premiums. Each premium quote has one unique strike price which "offers flexibility in establishing a price floor" (Anderson). The following passage further elaborates on the importance and application of option deltas:

"Delta is widely used in the stock options literature to define the slope of the premium-stock price curve. It may also be applied to options on futures. Delta can be used to establish a portfolio of options and futures for which the risk of a net change in value will be zero for small changes in the futures

FIGURE 1. PUT OPTION PRICE CURVE:

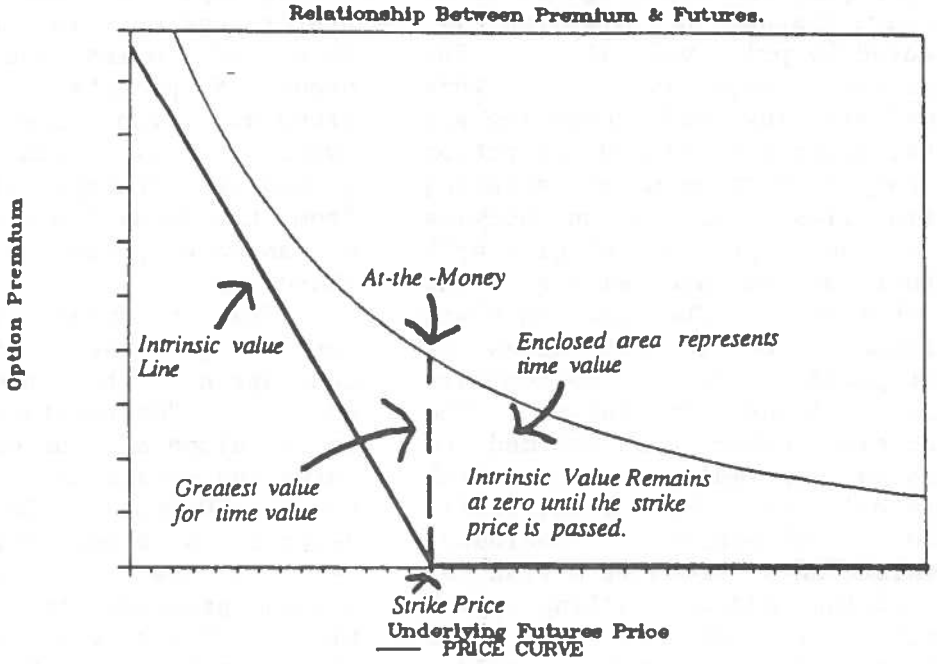
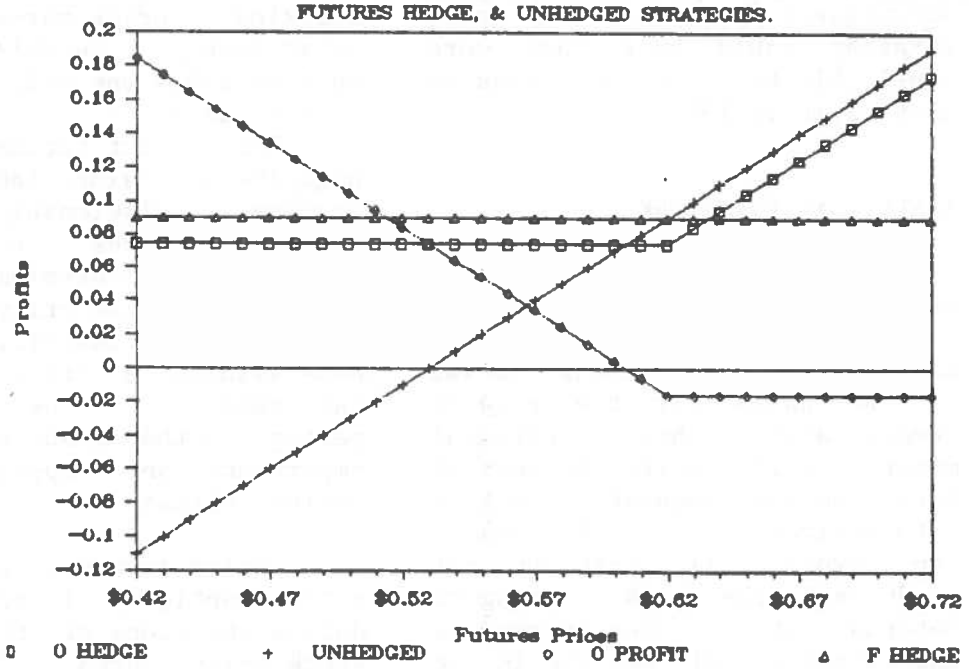


FIGURE 2. COMPARISON OF OPTION HEDGE,



price. For example, if delta equals 0.5, then, buying ten call options and selling five futures produces a balanced portfolio for small changes in the price of the futures. This portfolio must be adjusted continually in order to keep it riskless. For example, if the futures price changes so that delta equals 0.625, then two options must be sold to keep the portfolio riskless. Many stock option traders believe that delta should be 0.5 for an at-the-money option and greater (smaller) than 0.5 for an in-the-money (out-of-the-money) option, but this is not necessarily true for every futures option. However, the variables which determine delta are the same as those which affect the option's premium" (Wolf).

Figure 1, a theoretical price (premium) curve for put options, illustrates how an option premium is influenced by intrinsic and time value, ceteris paribus. The middle section of the curve represents an at-the-money put (strike price equals futures price). As long as the option is out-of-the-money (strike price less than futures price), each point reduction in the futures price adds nothing to intrinsic value, but increases time value. As soon as the option becomes in-the-money (strike price greater than futures price), time value decreases and intrinsic value begins to increase. Consequently, as the futures price declines even further below the strike price, "the change in the option premium becomes even more responsive to a change in the futures price" (Dalton).

A risk averse producer will most likely choose an at-the-money option because of the potential for gaining more in premium value from falling prices (intrinsic value) than with an out-of-the-money option. An in-the-money option is immediately more responsive to each unit change in the futures price. However, an at-the-money option can realize more value in the long run. This is shown by the increasing slope of the price curve above the strike price, helping to explain a risk averse producer's preference for an at-the-money put. This producer would prefer to lose less money via a cheaper premium in the event of rising prices. Losses in a bull market with an in-the-money put would be equivalent to the larger premium paid at initiation.

METHODS AND PROCEDURES

Alternative scenarios were developed to simulate traditional hedging and option hedging. A continuing comparison of futures prices with the estimated breakeven point for irrigated cotton enables a manager to determine the price at which to initiate a short position. The interrelationship between December 1985 futures prices, option premiums, and the estimated breakeven point of the hypothetical operation was used to determine the feasibility of an option purchase. The feasibilty of this options strategy depends on the relative levels of the option premium and the corresponding strike price. For instance, a large premium for a put option would require that futures prices fall substantially before reaching the breakeven point of the option.

December futures and Lubbock spot prices from May 1, 1985, to December 6, 1985, were used to determine the basis for grade 42,

staple 32 (42/32) cotton with micronaire readings of 3.5 to 4.9. Only grade and quality differentials were subtracted from base cotton quotes for Strict Low Midling 41 staple 34 reflecting a poorer classification (42/32) of cotton. This classification was the most prevalent in terms of pounds of cotton sold in the Southern High Plains in 1985.

A producer seeking to effect a "riskless hedge" must determine the number of contracts (options or futures) which will optimize his cash position. A "riskless hedge" supposedly eliminates all risk considering the standard deviation of both the spot and futures prices and the correlation coefficient of the two sets of prices (Radcliffe). This procedure, applied to the quantity of the commodity owned, identifies the optimal position the hypothetical producer should assume in the futures market. The cash position (240,000 lbs.) was derived from an estimate of total production. The formula used to derive a "riskless hedge" in the futures market is as follows:

Qty. in Futures = Qty. in Cash * [Standard Deviation of Cash / Standard Deviation of Futures] * Correlation Coefficient (Radcliffe).

Data used to compute the basis were also used to derive the correlation coefficient (R), the standard deviation of the futures prices, and the standard deviation of the cash prices. The calculated R value amounted to 0.49176 or approximately 50% demonstrating the percentage correlation of spot and futures prices. Conceptually, government programs for cotton and regional or world market conditions represent variables that could influence the R value. The inability or failure to include these variables could have contributed to the low R value.

Dispersion among the cash and futures data was measured by the standard deviation of each set of data. These values were calculated at 1.51518 and 1.69841, respectively. The formula for a riskless, futures hedge was applied as follows to determine the optimal position. The calculation is:

240,000 lbs. * [1.51518 / 1.69841] * .49176 = 105,290 lbs. or approximately 100,000 lbs. or two contracts @ 50,000 lbs. per contract.

A producer using a put option strategy initiates a "riskless hedge" by using the following formula to calculate the optimal number of options contracts to purchase:

Number of Options to Purchase = (Futures Position) * (1 / Option Delta) (Jarrow and Rudd).

It is generally accepted that deltas for at-the-money options will average 0.50 or 50%, meaning that as the futures price drops by one cent, the option value increases by only half that amount. The application of the formula allows a manager to compute the number of options required to optimize his cash position. For example, a producer choosing to purchase at-the-money puts and estimating their deltas to average 0.50 will purchase twice the number of option contracts as the number of futures contracts that he would sell.

The hedge positions were initiated on June 13, 1985, with the local basis estimated at 7.05

cents per pound. Option premiums paid upon purchase were taken from the June 1985 option quotes and were selected based on the price needed to break-even or to produce a positive net return. An at-the-money put with a strike price of 62.00 cents was priced at 1.57 cents per pound. The December futures price was also 62.00 cents on June 13. Budgets obtained from the A&M Experiment Station yielded an estimated breakeven price of 53.00 cents per pound for irrigated cotton in the Southern High Plains. Cotton (42/32) could have been sold in the cash market at 52.65 cents, 52.15 cents, and 51.15 cents on 10/21/85, 9/16/85, and 9/26/85, respectively.

FINDINGS

Tabular Comparison of Marketing Alternatives

Tables 1, 2, and 3 have in common the conditions mentioned above. The futures position of 105,290 pounds, or approximately two contracts was computed as described in the section on methods and procedures. Examination of the tables reveals the total revenue per pound generated by the options and futures stategies. These results can now be compared with those revenues obtained by selling in the cash market. Each outcome encompasses the total revenue generated. The computation for a "riskless hedge" was used to determine the optimal number of contracts (futures and options) required, which in effect incorporates an element of price risk into the analysis.

Table 3 ranks option hedging over futures hedging. This outcome is influenced by an empirical delta of 0.54 which indicates to the producer that he should purchase slightly less than four contracts. Options can only be bought in discrete numbers, however, forcing the hypothetical producer to buy four contracts. As a result of this over-bought position, the options hedge produces more returns than the futures hedge for this particular scenario.

The opposite situation occurs in Table 2 with an empirical delta of 0.61 and the purchase of 3 option contracts. Even though delta approaches one in this scenario, the purchase of just three options has a greater influence on the lower outcome of the option hedge as compared to the futures hedge. This occurs since options become deeper in-the-money as the futures price falls, and hence the options register a larger unit increase in value per unit decrease in the futures.

A delta of 0.40 and the purchase of five puts determines the outcome in Table 1. The futures hedge ranks first above both the options hedge and cash-sell strategies. In all hedge scenarios, the method of exercising options ranks slightly below that of offsetting options primarily because futures commissions are larger than option commissions. Increased risk encountered by exercising the option (entering the futures market) is thus a more costly operation.

Graphic Comparison of Marketing Alternatives

Figure 2, a comparison of option and futures hedges, illustrates the difference in the amount of risk involved in undertaking each of the three strategies. Assumptions include a break-even price of 53.00

Table 1. Results from Selling Futures, Buying Puts, & Cash Sale.

	1,2	OPTION 2,3	
	FUTURES	OFFSET	EXERCISE
Net Revenue	2,362	2,025	1,975
Revenue from Cash Sale	126,360	126,360	126,360
Total Revenue	128,722	128,385	128,335
Per lb of Production	53.63ct	53.49ct	53.47ct

1. Local Basis = 6.76 ct/lb. at offset
2. Offset Date = 10/21/85; Dec. Futures on 10/21/85 = 59.41 ct/lb.
3. Computation of Empirical Delta and Number of Option Contracts to Purchase. Futures: 62.00 - 59.41 = 2.59. Opt. Premium: -1.57 + 2.60 = 1.03. 1.03/2.59 = 0.40 or 40% (Delta). 1/.40 = 2.5. 2.5 * 105,290 lbs. Fut. = 263,225 lbs. Opt. Buy 5 Option Contracts.

Table 2. Results from Selling Futures, Buying Puts, & Cash Sale.

	1,2	OPTION 2,3	
	FUTURES	OFFSET	EXERCISE
Net Hedge Revenue	3,279	2,880	2,565
Revenue from Cash Sale	125,160	125,160	125,160
Total Revenue	128,439	128,040	127,725
Per lb of Production	53.52ct	53.35ct	53.22ct

1. Local Basis = 6.35 ct/lb. at offset
2. Offset Date = 9/16/85; Dec. Futures on 9/16/85 = 58.5 ct/lb.
3. Computation of Empirical Delta and Number of Option Contracts to Purchase. Futures: 62.00 - 58.50 = 3.50. Opt. Premium: -1.57 + 3.70 = 2.13. 2.13/3.50 = 0.61 or 61% (Delta). 1/.61 = 1.64. 1.64 * 105,290 lbs. Fut. = 172,675 lbs. Opt. Buy 3 Option Contracts.

Table 3. Results from Selling Futures, Buying Puts, & Cash Sale.

	1,2	OPTION 2,3	
	FUTURES	OFFSET	EXERCISE
Net Hedge Revenue	2,959	3,040	2,780
Revenue from Cash Sale	122,760	122,760	122,760
Total Revenue	125,719	125,800	125,540
Per lb of Production	53.38ct	53.42ct	53.31ct

1. Local Basis = 7.67 ct/lb. at offset
2. Offset Date = 9/26/85; Dec. Futures on 9/26/85 = 58.82 ct/lb.
3. Computation of Empirical Delta and Number of Option Contracts to Purchase. Futures: 62.00 - 58.82 = 3.18. Opt. Premium: -1.57 + 3.37 = 1.73. 1.73/3.50 = 0.54 or 54% (Delta). 1/.54 = 1.85. 1.85 * 105,290 lbs. Fut. = 194,706 lbs. Opt. Buy 4 Option Contracts.

cents/lb., a strike price of 62.00 cents/lb., a premium of 2.00 cents/lb., a constant basis (100% correlation between the cash and futures market), and a delta of 1.00. The graph was constructed using Lotus software which rounds the actual premium (1.57 cents/lb.) used in the comparison to 2.00 cents/lb.

The possible outcomes in both a rising and falling market shown in Figure 2 are based on the assumptions listed above. A producer, according to this graph, could have locked in both a seven cent profit with the option hedge (curve with squares) and a nine cent profit with the futures hedge (horizontal, unmarked curve), the two cent difference between the hedges being, of course, the premium.

The hedge curves also indicate price floors at their lowest points. The price floor of the option hedge is established when the futures price falls below the strike price of 62.00 cents/lb., causing the option to generate profits (curve with diamonds). Profits made in the futures market are not shown on this graph but are reflected in the futures hedge curve. These profits offset the losses in the spot market caused from falling prices generating a "price floor" or "locked-in-profit."

Focusing on the put and futures hedge curves one can see that as prices fall below 62.00 cents (the price at which the short position is initiated), no losses will occur if we assume zero transaction costs. As prices rise above 62.00 cents, a producer would realize losses in the futures market and would face potential margin calls. As prices fall below 62.00 cents (also the exercise price of the option) in a put hedged position, losses are limited to the premium paid assuming no commissions. The cash position entails the greatest measure of price risk because of the producer's susceptibility to price variation.

Evaluation of Basis Risk

Basis movement greatly influences the success of hedging with futures. "At times the premium price of the futures (over the cash price) is not at full carrying charges (Horn)." Hence the short futures hedge does not completely protect the producer from price risk, and "it may result in temporary losses if the basis widens" (Horn).

Basis movement affects the success of option hedging because of the functional relationship between an option premium and its underlying futures price. It is important to realize, however, that no matter how wide the basis becomes or how far prices rise, the most that can be lost from the options position is the premium paid by the purchaser. A short futures position in a bull market with a widening basis, in contrast, can produce substantial losses in the futures market with smaller compensating returns from the bull spot market. The short hedge in such a scenario would actually show a loss over the unhedged position.

Both a narrowing and a subsequent widening basis occurred during the 1985 production season. The widening basis resulted from a bull futures market and a simultaneous bear spot market. A producer in the Southern High Plains could have benefited from hedging at this time as shown by the tables. This follows even though the basis widened up to a certain point at which no benefits would

have been realized. If the basis had narrowed throughout the production season, hedging strategies could have been more successful; and the hypothetical producer would not have moved to offset or exercise his positions as early.

LIMITATIONS

The findings in this study were based on past data; no predictions of futures and cash prices were used. Futures and cash market data assembled for a five year period would likely have provided more accurate computations of the correlation coefficient and standard deviations. Nonetheless, the results proved positive indicating the feasibility of options or futures hedging for High Plains producers.

The remaining variables which conceivably affect the premium levels were held constant since volatility of futures price was considered to be most influential. Hence, deltas computed in this research are empirical. A number of investigators have used the "Black and Scholes Option Pricing Model" to incorporate all four variables in the option valuation. Use of this model, however, was beyond the scope of this project.

SUMMARY AND CONCLUSIONS

The primary objective of this project was to compare and evaluate the risk distribution capacity of selling in the cash market at harvest, hedging with futures, and hedging with put options. Criteria used in the evaluation included gross returns, risk versus return trade-offs, strengths and weaknesses of the strategies under specific market conditions, and effects of margins, premiums, and commissions on the success of the strategies. The outcomes effectively support the theories and concepts discussed. For instance, in two of the three scenarios futures hedging ranks first, considering net returns, over option hedging; the cash sell strategy ranks last in all three scenarios.

The findings indicate that cotton producers in the Southern High Plains can, with proper timing and under certain market conditions, reduce price risk by hedging with futures or options. Returns generated by the hedged positions for the hypothetical operation are large enough to add to the low and relatively stable cash price received at harvest for 42/32 cotton. The absence of both price convergence and the perfect correlation of spot and futures prices makes the "perfect hedge" impractical and inapplicable forcing the use of a risk adjusted hedge to conform to the variable basis.

One might argue that the strategies are speculative because the option and futures positions are offset prior to sale in the cash market and with time remaining before expiration This argument is valid considering the possibility that prices could have fallen considerably after offset. However, calculations by a producer as prices rose would have proven early offset or exercise to be a sound move because the estimated break-even price, and possibly more, could have been obtained. This argument lends suport to the risk averse attitude of desiring to hedge price risk to stabilize cash flow. Presumably, a producer desires to offset his position as the basis narrows to

a specified level. His choice of basis level would in each instance be determined by his knowledge of historical records and his past experience.

The researcher can argue that hedging with put options better fulfills a risk averse producer's desire for optimum returns with minimal risk. Such a position may seem abstract, however, it is supported by the intrinsic properties of put options: price insurance in conjunction with unlimited profit potential.

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