

ECONOMICS & MARKETING

Evaluation of Cotton Put Options as a Price Risk Management Tool

Blake K. Bennett

ABSTRACT

The commodity production sector has attempted to manage price risk through the use of futures and options contracts, but producers are faced with a limited amount of time to analyze factors necessary to determine the optimal time and strike price to purchase cotton put options to protect their price. The objective of this research was to develop an easily understood strategy that would save time and assist cotton producers using the December cotton options market to hedge price risk. Daily December cotton futures, option strike prices, and premium values from 1 May through its expiration from 1985 through 2000 were analyzed for this study. Since futures and options contracts are traded Monday through Friday not including holidays, like dates could not be compared across years. Therefore, a standardized method was developed so comparisons could be made for like time periods across years. This standardized method involved the division of each month for each contract into three time classifications. Each contract's average premium value for at-the-money put options associated with each time period was analyzed in relation to the corresponding average price associated with the first ten days of November. Results of this study indicated that put options purchased four cents in-the-money between 21 and 31 May provided the highest net price. Specifically, net price was increased by \$0.0167 per pound on average over the study period when using these criteria.

Production agriculturalists across the USA are attempting to manage production risks and price volatility in order to maintain a desired level of profitability. Attempts have been made to provide revenue security through crop insurance, but this has not proven to be very successful in the cotton sector

(Herndon et al., 1999). Another means by which the commodity production sector has attempted to manage price volatility is through the use of futures and options contracts. Specifically, Hurt et al. (1991) found that soybean prices received by farmers familiar with futures markets averaged 3.9% higher than those not familiar with these markets. Furthermore, Johnson and Bennett (2000) found that cotton producers can use moving averages to identify changing cotton futures market trends and select entry and exit points for hedges. Results of this study indicated that cotton producers could add on average an additional \$0.02 per pound to the final price they receive for cotton by making trades throughout the year based on moving averages. Similarly, Elam (2000) found that the cotton futures market tended to revert back to a long-run average price. This study suggested that cotton producers could base hedging decisions on whether or not the current futures price is above or below the long-run average. Bennett and Reeves (2001) also found that cotton producers who sold cotton futures contracts between 11 and 20 June with a \$0.015 stop order increased net returns by \$0.0379 per pound over the study period. Finally, Herndon et al. (1999) examined the use of a harvest strategy in which cotton producers sell cotton at harvest, purchase at-the-money July call options, and exercise these options eight months later. This strategy increased the net price and farm revenues by an average of \$0.0606 cents per pound over the study period.

Although the cotton futures market can be used to establish a minimum price for a commodity, margin requirements and the inability to take advantage of upward movements in price may make this alternative unattractive to some producers. Therefore the options market has become an increasingly popular means of hedging price risk. Specifically, agricultural producers who purchase put options at a particular strike price prior to harvest pay a premium plus commission for that option and have no other financial obligation. If the market price falls below the level of the strike price at which the option was purchased prior to contract expiration, the put op-

tion may be exercised or offset to capture the additional income. If market prices remain greater than the strike price of the purchased put option throughout the remainder of the contract, the option expires worthless and the producer will lose the initial premium and commission paid.

When deciding whether or not to use put options as a marketing tool, the strike price and associated premium levels along with an individual's cost of production must be taken into consideration. Producers are faced with limited available time for analyzing these factors when attempting to make a decision. While the cost of production may vary by operation, and should be analyzed on an by-operation basis, an understandable set of guidelines that will assist producers in the determination of the optimal time and strike price level which has provided the highest net price is needed. The objective of this research was to develop an easily understood strategy that would save time and assist cotton producers using the December cotton options market to hedge price risk.

METHODS AND PROCEDURES

For the purposes of this research, it was assumed that producers would enter and exit the options market only once during the life of each contract. Furthermore, at-the-money or in-the-money put options were offset rather than exercised, if possible, at contract expiration.

Study Data. Historical daily December cotton futures and option strike prices and premium values from 1 May through contract expiration from 1985 through 2000 were analyzed for this study. Options data was obtained from the New York Board of Trade (New York, NY) and Commodity Systems Incorporated (Boca Raton, FL). Since futures and options contracts are traded Monday through Friday not including holidays, like dates could not be compared across years. Therefore, a standardized method similar to that used by Bennett and Reeves (2001) was developed so comparisons could be made for like time periods across years. This standardized method involved the division of each month for each contract into three time classifications (first through the tenth, eleventh through the twentieth, and the twenty-first through the end of the month). The daily cotton futures prices and option premiums for like strike prices were then averaged per time classification.

Hedging. Each contract's average premium value for at-the-money put options associated with each time period was analyzed in relation to the corresponding average price associated with the first ten days of November. If the strike price associated with the at-the-money put options were still being traded during the first ten days of November, the purchased options were offset. If the strike prices were not being traded during the first ten days of November, the option was exercised and the futures position was then offset. This yielded all potential outcomes that could have been produced through the purchase and later offsetting or exercising of a cotton put option. A similar approach was used to evaluate cotton put options one, two, three, and four cents in-the-money and out-of-the-money at the time of purchase. Furthermore a \$25 per contract commission charge per round trip was also assessed whether the purchased put option was offset, exercised, or expired worthless. The resulting potential revenues for each contract were then averaged, and the time period and level of strike price (at-the-money or one, two, three, or four cents in-the-money or out-of-the-money) that provided the highest returns were identified.

Effects on Net Price Received. Returns from purchasing a put option using the time period and strike price level determined by this study (expressed in 1982 to 1984 dollars) were then added to the average price received by Texas producers for cotton (expressed in 1982 to 1984 dollars) (USDA 2000, 1997, 1994, 1991, 1988, and 1985). It should be noted that on dates where no put options were available to be purchased (the specific put option was not traded), it was assumed that no position was taken and only the average price received for cotton was analyzed. The mean price received for cotton without hedging (average price received by Texas producers for cotton) was then compared to the mean net price received for cotton using the date and strike price selection process of this study using a paired t-test. Since a larger variance would suggest a greater variability in net revenues generated from the use of the cotton options market, the variances of the net returns from utilizing the cotton options market while using the date and strike price selection process was also compared with the variance of the average price received by Texas producers for cotton to determine if they were statistically different.

RESULTS

The results of this study are presented below in two sections. The first section presents the results of the date and associated strike price levels that provided the highest net returns from purchasing the various cotton put options. The effects of the purchase of put options between four cents out-of-the-money and four cents in-the-money on the net price received for Texas cotton are presented in the second section.

Returns from Hedging with Put Option. Cotton put options purchased near planting time and in-the-money provided the greatest returns over the range of data (Table 1). Specifically, cotton put options purchased four cents in-the-money between 21 and 31 May produced the greatest average return of \$0.0167 per pound. Likewise, 21 and 31 May was the period that produced the greatest average returns for cotton put options purchased three and two cents in-the-money, but these average returns (\$0.0137 and \$0.0101 cents per pound, respectively) were less than

Table 1. Results from purchasing out-of-the-money, at-the-money, and in-the-money put options for 1985 through 2000

Purchased Put Option	Put Option Purchase Date	Premium Paid (cents/lb.)	Years Having Positive Gains (%)	Average Net Gain/Loss (cents/lb.)
Cents Out-of-the-Money				
4	6/11 – 6/20	1.89	25.00	-0.04
3	6/11 – 6/20	2.07	31.25	-0.02
2	6/11 – 6/20	2.43	37.50	0.12
1	6/11 – 6/20	2.89	43.75	0.18
At-the-Money	6/11 – 6/20	3.37	43.75	0.29
Cents In-the-Money				
1	6/11 – 6/20	3.77	43.75	0.83
2	5/21 – 5/31	4.48	50.00	1.01
3	5/21 – 5/31	4.87	56.25	1.37
4	5/21 – 5/31	5.49	43.75	1.67

Table 2. Potential put option returns between 1985 and 2000

Purchased Put Option	Potential Trades Resulting in Negative Returns (No.)	Potential Trades Resulting in Positive Returns (No.)	Potential Trades (No.)	Potential Trades Resulting in Positive Returns (%)
Cents Out-of-the-Money				
4	203	51	254	20.08
3	222	57	279	20.43
2	216	68	284	23.94
1	204	80	284	28.17
At-the-Money	190	94	284	33.10
Cents In-the-Money				
1	174	100	274	36.50
2	163	104	267	38.95
3	144	106	250	42.40
4	128	95	223	42.60
All Trades	755	1,644	2,399	31.47

those associated with the purchase of put options during this same time period at four cents in-the-money. Average returns continued to decline for put options purchased between one cent in-the-money and four cents out-of-the-money; however, put options with these relative strike prices should be purchased between 11 and 20 June.

Put options purchased further in-the-money produced a greater percentage of positive trades compared with put options purchased out-of-the-money using the dates discussed above (Table 1). Specifically, 25% of the put options purchased four cents out-of-the-money between 11 and 20 June produced positive trades compared with about 44% positive trades for at-the-money put options purchased between 11 and 20 June. The percentage of positive trades produced using the trading dates discussed above continued to increase as the purchased put options moved further in-the-money with the exception of put options purchased four cents in-the-money between 21 and 31 May. This trend was also observed when all potential trades made over the range of data are examined rather than just the dates

suggested above as producing the greatest average return (Table 2). Specifically, about 20% of the total number of four cent out-of-the-money put option purchases that could have occurred over the range of data were positive compared with about 33% of the at-the-money and about 43% of the four cent in-the-money put option potential purchases.

The average individual returns from all potential out-of-the-money, at-the-money, and in-the-money trades are presented in Table 3. Based on this information, a four cent out-of-the-money cotton put option purchased between 21 and 31 May would have produced a negative options gain of 0.53 cents per pound on average over the range of data (Table 3). Similarly, a four cent in-the-money put option purchased between the same two dates would have produced a positive options gain of 1.67 cents per pound.

Effects on Net Price Received. The effects of purchasing put options between four cents out-of-the-money and four cents in-the-money on the average price received by Texas producers for cotton along with the price series means are presented in

Table 3. Average returns from all potential trades from 1985 through 2000

Entry Date	Returns (cents/lb.)								
	Out-of-the-Money				At-the-Money	In-the-Money			
	4	3	2	1		1	2	3	4
5/01-5/10	-0.33	-0.68	-0.67	-0.55	-0.64	0.23	0.67	0.47	-1.50
5/11-5/20	-0.24	-0.34	-0.28	-0.08	-0.11	0.67	0.76	0.65	0.34
5/21-5/31	-0.53	-0.54	-0.42	-0.25	-0.07	-0.06	1.01	1.37	1.67
6/01-6/10	-0.45	-0.35	-0.33	-0.32	-0.16	0.39	0.12	0.35	0.15
6/11-6/20	-0.04	-0.02	0.12	0.18	0.29	0.83	0.87	0.36	-1.25
6/21-6/30	-0.06	-0.20	-0.01	0.02	0.11	0.33	-0.24	0.32	-1.01
7/01-7/10	-0.64	-0.65	-0.60	-0.65	-0.58	-0.46	-0.69	-0.45	-0.76
7/11-7/20	-0.65	-0.62	-0.65	-0.64	-0.51	-0.52	-0.55	-0.36	-0.56
7/21-7/31	-0.50	-0.52	-0.50	-0.53	-0.51	-0.68	-0.14	-0.75	-0.24
8/01-8/10	-0.51	-0.55	-0.62	-0.68	-1.17	-0.65	-0.89	-0.33	-0.98
8/11-8/20	-0.54	-0.65	-0.70	-1.22	-0.75	-1.25	-0.66	-1.17	-0.36
8/21-8/31	-0.39	-0.42	-0.46	-0.52	-0.55	-1.02	-0.38	-0.98	-0.17
9/01-9/10	-0.52	-0.59	-0.65	-0.75	-0.77	-0.74	-1.11	-0.65	-0.42
9/11-9/20	-0.41	-0.39	-0.38	-0.35	-0.34	-0.07	-0.56	0.26	-0.37
9/21-9/30	-0.25	-0.22	-0.22	-0.15	-0.13	-0.09	0.15	-0.01	-0.18
10/1-10/10	-0.25	-0.22	-0.17	-0.15	-0.17	-0.13	0.04	0.13	0.69
10/11-10/20	-0.29	-0.38	-0.50	-0.56	-1.22	-0.67	-0.54	-0.53	-0.32
10/21-10/31	-0.15	-0.22	-0.33	-0.47	-0.65	-0.72	-0.66	-0.69	-0.80

Table 4. When the mean net prices produced from purchasing put options were compared with the mean price received by Texas producers for cotton, results indicate put options purchased between four cents out-of-the-money and three cents in-the-money using the dates that produced the greatest net returns were not statistically different from the mean price received for Texas cotton at the 0.15 level of probability (Table 5). The mean net price from purchasing four cent in-the-money put options between 21 and 31 May was statistically significant at the 0.15

level of probability. An *F* test of the variances of the price series indicates that the variances of the distributions of using put options were not statistically different from the variance of the average price received by producers for Texas cotton. These findings indicate that the purchase of put options during the time periods discussed earlier did not increase or decrease the variability in net returns and only significantly increased the net price received for cotton when the option was purchased four cents in-the-money.

Table 4. Average price received by producers for Texas cotton and net returns from purchasing put options (1982 to 1984 = 100)

Year	Avg. Cash Price Received (cent/lb)	Net Returns from Purchasing Put Options								
		Cents Out-of-the-Money				At The Money	Cents In-the-Money			
		4	3	2	1		1	2	3	4
2000	29.85	28.80	28.59	28.36	28.11	27.85	27.61	29.85	29.85	29.85
1999	24.85	24.74	25.02	25.34	25.66	25.95	26.23	27.40	27.91	27.82
1998	35.64	36.60	36.95	37.31	37.62	37.92	38.20	36.58	35.88	36.99
1997	37.45	36.72	36.94	37.25	37.60	37.89	38.16	37.84	37.94	37.45
1996	41.81	41.24	41.54	41.90	42.22	42.53	42.82	44.67	45.83	45.42
1995	48.95	46.87	46.59	46.31	46.01	45.70	45.37	44.93	44.69	48.95
1994	46.90	45.73	45.51	45.26	44.97	44.66	44.70	45.11	45.30	46.90
1993	37.02	36.02	35.83	35.69	35.66	35.77	35.99	36.90	37.90	37.41
1992	35.00	37.52	37.93	38.65	39.06	39.43	39.77	36.58	38.83	37.35
1991	39.35	43.99	44.50	44.95	45.38	45.79	46.53	46.94	46.87	39.35
1990	48.36	46.74	46.49	46.37	45.81	45.81	48.36	48.36	48.36	48.36
1989	47.58	46.48	46.21	45.91	45.52	45.12	45.23	47.55	44.79	47.54
1988	43.62	46.91	47.31	47.94	48.49	48.77	49.92	45.07	45.88	45.69
1987	52.46	50.71	50.84	51.12	51.49	51.85	52.21	52.46	52.46	52.46
1986	42.06	42.06	41.41	40.98	40.67	40.09	39.56	38.58	38.20	37.28
1985	47.96	47.96	47.31	47.06	46.63	46.93	47.38	48.70	50.07	49.05
Avg. Price Rcvd.	41.18	41.19	41.19	41.28	41.31	41.38	41.75	41.72	41.92	41.74

Table 5. Results of the paired t-tests and analysis of variance (*F*) between the average price received for cotton by Texas producers and the net price from hedging with the use of put options

Statistic	Average Price Received for Cotton by Texas Producers and Purchased Put Options								
	Cents Out-of-the-Money				At the Money	Cents-In-the-Money			
	4	3	2	1		1	2	3	4
t value	-0.028	-0.014	-0.158	-0.185	-0.269	-0.714	-0.817	-0.967	-1.204
<i>P</i>	0.489	0.495	0.438	0.428	0.396	0.243	0.213	0.174	0.124
<i>F</i> ^z	1.088	1.114	1.125	1.140	1.136	1.058	1.140	1.175	1.089

^z The critical *F* value was 3.80. Since all values for *F* were less than 3.80, the variances are homogeneous at *P*=0.01.

CONCLUSIONS

Greater returns were associated with the purchase of cotton put options further in-the-money over the range of data. Furthermore, a greater percentage of trades resulting in positive returns were observed at higher strike price levels relative to the underlying futures price at the time of purchase. While the results of this study do not indicate that market conditions will persist into the future that will produce similar results, this study does indicate that strike prices further in-the-money warrant examination when attempting to hedge price risk using cotton put options. It should also be noted, that only the December put option contract was evaluated by this study. Therefore, no inference should be made concerning the use of this strategy with other cotton put option contracts without first evaluating the performance of those contracts.

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